

# net Finishing

APPLICATIONS, ELECTRODEPOSITION, VITREOUS ENAMELLING,  
ANODIZING, METAL SPRAYING and all METAL FINISHING PROCESSES

Vol. 4 No. 37 (new series)

JANUARY, 1958

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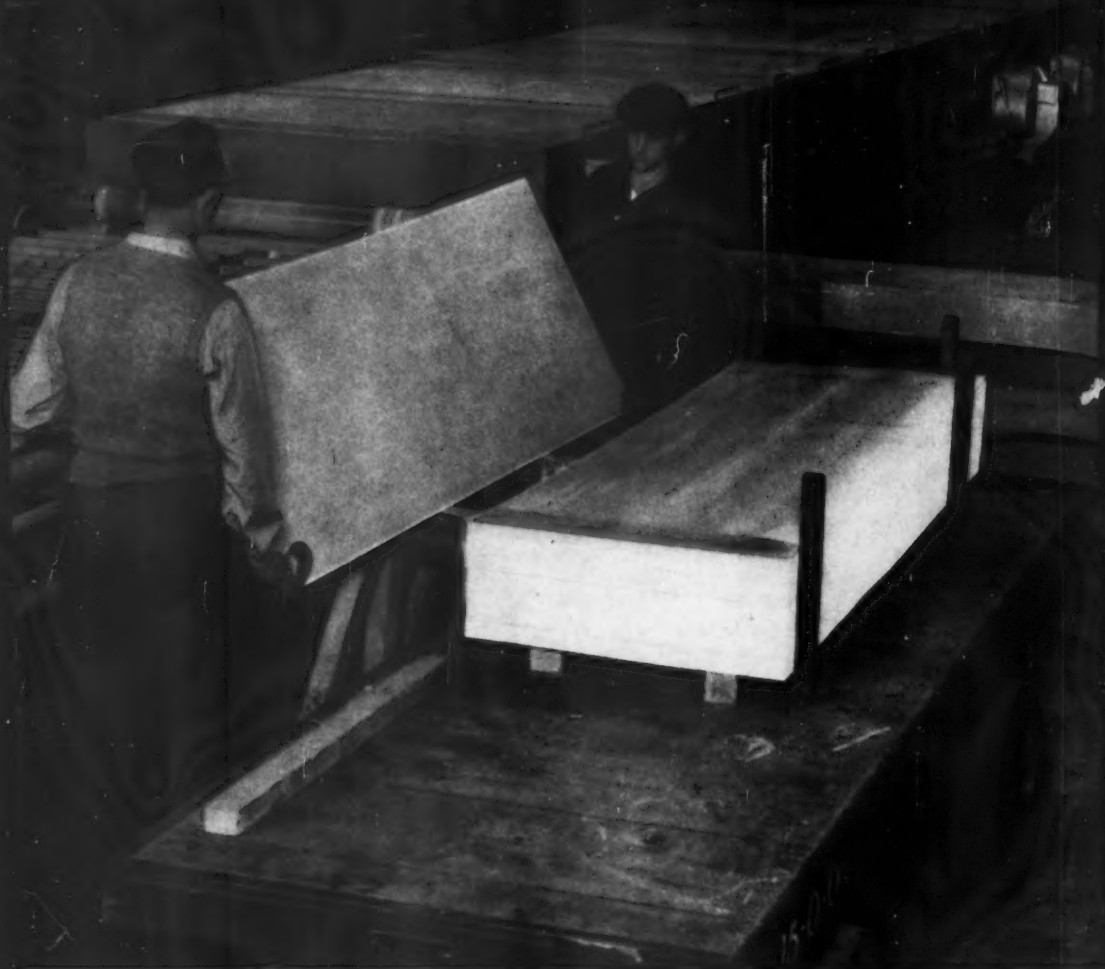
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# metal finishing Journal

January, 1958



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THIS JOURNAL IS DEVOTED TO THE SCIENCE AND TECHNOLOGY OF PAINT APPLICATION, ELECTRODEPOSITION, VITREOUS ENAMELLING, GALVANIZING, ANODIZING, METAL SPRAYING & ALL METAL FINISHING PROCESSES. THE EDITOR IS PREPARED TO CONSIDER FOR PUBLICATION ANY ARTICLE COMING WITHIN THE PURVIEW OF "METAL FINISHING JOURNAL" AND ALL SUCH ARTICLES ACCEPTED WILL BE PAID FOR AT THE USUAL RATES.

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# THE INDUSTRY

*IT* has become customary through long usage to refer, both in these pages and elsewhere, to the metal-finishing industry as if it were a close-knit and easily definable entity whose purpose and direction could be covered by a single set of common criteria. Close analysis however, of such a concept reveals it as being so far from realistic as to justify doubts as to whether the metal-finishing industry can properly be said to exist as such at all.

The very wide range of entirely differing processes and technologies comprised in the term finishing are catered for by an equally wide variety and number of companies, many of which are so far removed from each other from the technical viewpoint as to be not even in commercial competition.

Subjects such as paint, electrodeposition, hot-dip galvanizing and vitreous enamel, are represented by industries which are broadly self-contained and have little impact on, or association with, each other.

On the application side, while there is a small and select body of individuals who are responsible for the control and use of a wide range of different finishing processes, the greater number of finishing personnel is normally concerned on a much more restricted front. The foreman of an electroplating shop has as little in common, technically speaking, with the foreman of a paint shop as he would have with the foreman of a brewery.

Nevertheless, for obvious industrial reasons, metal finishing must be treated under a common technological umbrella. The difficulties and problems inherent in such a position are patent and relate particularly to coverage in the technical literature and to the financing of research. Among the separate industries which go to make up the metal-finishing body, only the paint industry has sufficient resources to sponsor its own research organization. Research and development in the other branches of metal finishing is carried out either by individual companies or on a somewhat piecemeal and ad-hoc basis in other research associations.

The contribution made by efficient individual companies with adequate resources can be of great importance, and in fact, the greater part of the progress in the electroplating industry in this country, which has taken place in recent years, has stemmed from this source. On the other hand the amount of fundamental investigation at present being carried out into the basic theory of finishing processes can hardly be regarded as satisfactory and such is likely to remain the case until and unless adequate finance to cover the cost of such research can be forthcoming. It is an interesting sidelight on the prospects of adequate finance being made available to note that the Institute of Metal Finishing which claims to represent the technical interests of electroplaters, anodizers and painters, showed a substantial deficit on its account for the past year's working.

It can hardly be denied that the Institute of Metal Finishing performs a useful function in disseminating information and promoting discussion on those aspects of metal finishing coming within its purview. If even this technical activity cannot be carried on without financial loss, the prospects of any larger-scale appropriation for that amount of research without which technical progress must become desultory, would appear to be remote.

# Talking Points

by "PLATELAYER"

TOPICAL COMMENT  
FROM THE MAIN  
LINES AND SIDE  
LINES OF METAL  
FINISHING

## SUPER TESTING STATION.

**O**UTDOOR exposure testing of panels of various metals and finishes is starting in the United States on a scale which makes all previous programmes almost insignificant by comparison; and the results will be there for all to see. Quite a number of aluminium-faced buildings are now in existence in various parts of the States, and in New York a thirty-four storey skyscraper faced entirely in gold-anodized aluminium is now in course of being completed. This will be the first of its kind in the world. We may wonder if the colour will be more lasting than in the case of the pink panels with which one of the Seine bridges was covered during the Paris Exhibition of 1937. By the end of the show, most of the panels had reverted almost to the colour of natural aluminium. No doubt there has been some progress in the past twenty years in developing light-fast colours and it will be interesting to see how long it will be before the "gold" is transmuted to "silver" this time.

The forty-five storey Socony-Vacuum building in New York, which is probably the largest metal-clad building in the world, is faced with stainless-steel panels; these have a deeply pressed pattern applied to them, and should in due course provide much useful information on crevice corrosion. Let us hope the results are not disappointing. The building which is most likely to worry its owners, however is the Seagram Building in New York; this is being faced in glass and polished bronze—all thirty-eight storeys of it. By the time the weather has done its worst, it will probably take all the metal polish in the U.S.A. to restore the bronze to its pristine brightness, unless they compromise with a green patina. Never have metal finishers had such a vast testing laboratory put at their service before!

## INACTIVE RADIO-ACTIVITY.

The more one learns about the possibilities of the use of radio-isotopes in electro-deposition, research, the more surprising it is that so little use has been made of them in this field. A glance through recent literature will show that extremely few research papers have been published in this country where use has been made of these materials. Yet the methods are relatively simple, and information can be obtained which is literally unobtainable in any other way. Such mechanisms as the dissolution of anodes and what happens to organic brighteners can be readily studied and a wide range

of compounds, both organic and inorganic can readily be obtained for carrying out the work. Probably unfamiliarity with the techniques may be the cause and also, perhaps, a mistaken belief that expensive apparatus and elaborate safety precautions are needed. This is by no means the case with a large proportion of the commonly used isotopes.

With a little imagination one can see the possibility of quite a few subjects for Ph.D theses which might be developed without too much effort!

## IS THIS YOU ?

An American consulting firm has carried out a survey to determine the type of man who goes into engineering. The conclusions reached are that the engineer is a strongly work-oriented, precise, tense, energetic, practical individual with little interest in tangible questions. He has little vision beyond the immediate problem, but he respects authority and has a strong sense of responsibility. The engineer is sensitive to recognition, tends to identify himself more with his profession than his employer and is often critical of the relation of his department to other departments. Most of all, however, he feels that only a small part of his time is spent on work suited to his unique abilities. All this is tantamount to an allegation of egoism and narrow-mindedness.

The reference is, of course, to American engineers; let us hope that ours are rather less insular.

## ELECTROSTATICALLY KIPPERED.

An interesting development of the electrostatic spraying method has been described recently. It seems that a considerable increase in the speed with which kippers can be smoked may be achieved by using the method to precipitate the smoke electrostatically on to the kippers instead of letting most of it escape up the chimney. This is another case of an unexpected market for a process designed for an entirely different field.

## ELECTROPHORETICS.

The use of electrophoretic methods for the deposition of metals which cannot be economically plated from solutions is not a new idea, but it is interesting to see that it has been applied to molybdenum recently. The metal is finely dispersed in an organic solvent, and high voltages are employed, although the current density is only very small. The coating (which forms at the rate of about 0.006 in. per minute) is densified by hydrostatic pressure and finally sintered.

## POLISHING

## Aluminium and Its Alloys

**Details of a New Chemical Process**

By

W. K. Bates\* and C. D. Coppard\*

CHEMICAL methods of polishing a variety of metals have been developed since the war, and today these methods not only supplement but frequently are replacing equivalent electropolishing techniques.

In common with electrolytic methods, the theory of chemical polishing appears to have a number of 'blank spots' which are as yet unexplained. This article does not seek to explain them but outlines the basic mechanism and some of the properties of a new process for chemically polishing aluminium and its alloys. The process, developed and manufactured by Albright & Wilson (Mfg) Limited, is called Phosbrite 159 and is one of a range of chemical processes for polishing aluminium, nickel, copper and copper alloys (including basis and cartridge brass and gilding metals).

**Basis of the Process**

Since most chemical polishing solutions are based on a mixture of strong acids, it would be expected that metal immersed in them would become etched and lose metal about equally from the depressions and high-spots. In fact, the Phosbrite solution (as well as some others) removes metal selectively from the high-spots and without forming definable etch patterns. Any description of this type of process, therefore, is centred primarily on explaining these two phenomena.

A partial explanation of both problems lies in the formation and dissolution of films at the metal-solution interface; and the fact that all these polishing solutions contain nitric acid or other oxidants (such as  $H_2O_2$  or chromic acid) had led to the belief that nitric acid ennobles the metal surface by the formation of a passive film.

This view is supported by data from weight-loss/time experiments on aluminium in solutions with and without nitric acid. In an orthophosphoric-

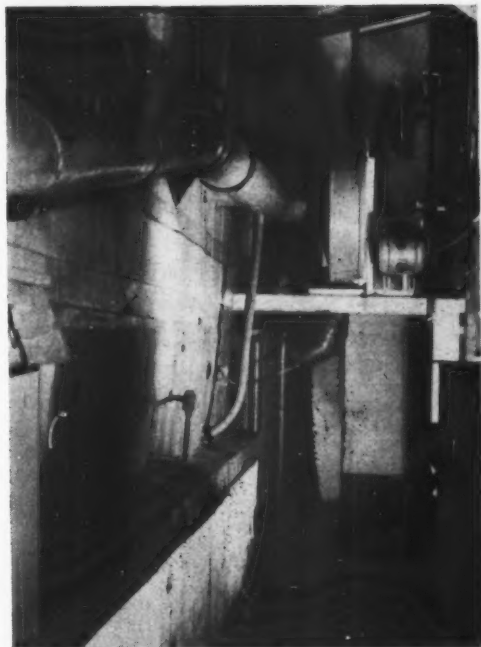


Fig. 1.—Fume-extraction and scrubbing equipment on the Phosbrite 159 plant at the works of Haynes, Ford and Elliot Ltd., Birmingham 6.  
(Courtesy of Haynes, Ford and Elliot Ltd.)

sulphuric-acid bath the loss-of-weight curve is proportional to time: the solution does not polish but produces a bright etch. When nitric acid is added to this bath the curve is no longer linear (the weight loss decreasing and eventually tailing off) and bright polished surfaces are produced. Similar results have been found with orthophosphoric/acetic/nitric-acid solutions. Arguments in favour of the presence of a film on the metal surfaces have been reinforced by the mercury drop wetting test, conducted by Hoar and Farthing with electropolishing solutions and by McG. Tegart with

\*Albright and Wilson Ltd.



Fig. 2.—Examples of aluminium parts before and after treatment in the plant shown in Fig. 1.  
(Courtesy of Haynes, Ford and Elliot Ltd.)

chemical polishing solutions. Because there are considerable pH rises at the metal-solution interface, and the solutions contain strong oxidizing agents, it is assumed that these films are oxides or hydroxides.

The specific role of nitric acid is interesting because it is known that in the absence of nitrous acid it has no effect on, for instance, copper, silver or mercury, while the reaction of other metals is slow. In other words, while the presence of nitric acid plays an important part in the polishing mechanism, it is difficult to see how this is true of the pure acid. In the case of aluminium, the reaction products are aluminium oxide and nitrous acid. The dissolution of the metal is apparently controlled by the oxide film which in turn is reduced by the nitrous acid. In a bath such as the Phosbrite 159 solution, this formation and reduction of the film is a continuous process, the development of oxide being favoured also by the rise in pH of the bath at the solution-metal interface.

Preferential removal of metal from the high-spots (smoothing) is not only due to electrochemical action, it is clear that it also owes something to the presence and properties of a viscous layer which is also formed at the solution-metal interface. This layer is formed in the Phosbrite solution because the dissolution products of orthophosphoric-acid-based solutions are more viscous than the solutions as a whole. These products, then, adhere to the

metal surface and form a comparatively thick layer. In the course of the reaction a point is reached at which the layer contains no more anions capable of linking with the metal ions. The rate of attack is now controlled by the layer which acts as a barrier to fresh anions that diffuse from the bulk solution. Preferential attack on the high-spots is due to the anion concentration between metal and the layer/solution interface being greater at the high-spots than at the depressions.

It seems likely that the viscous layer is responsible for the 'smoothing' process—that is, removal of the larger surface irregularities. The surface oxide film promotes the brightening process which involves the removal of smaller surface irregularities.

### Different Polishing Methods

Views on the relative merits of mechanical, electrolytic and chemical methods of polishing aluminium differ widely, presumably according to personal affiliations to any one method. Each method has advantages over the other two, but none has such all-round superiority as to be likely to replace the others.

Mechanical polishing achieves its effect by causing the metal surface to flow, so that high-spots are forced down into the depressions. The surface is thus seriously deformed. Between this surface zone (called the Beilby layer) and the bulk metal there is an intermediate zone of deformed metal which varies in thickness according to the type of metal and polishing equipment employed. The disadvantages of this method of polishing are that the work undergoes great stress and that the surface of the metal acquires different properties from the bulk metal. Mechanical polishing, however, continues to be widely used as a preparatory treatment because electrolytic methods and, in many cases, chemical methods cannot remove machining and forming marks without extending treatment times beyond their economic limits.

Electrolytic brightening solutions for aluminium vary in make-up and in details of application, but in general their main limitation is that they produce surface of high specular reflectance only on S.P. aluminium and its alloys of 99.98 per cent purity or better. The quality of the finish decreases strikingly as the impurity content rises. In addition the surface of the metal must be homogeneous: large grain-sizes or broken surfaces result in poor specularity and, often, in imperfections becoming revealed or even exaggerated. However, within these limitations, it is thought by many experts that electrolytic brightening has slight but definite advantages over the other two methods in quality of finish.

Electropolishing solutions are available for producing polished surfaces on commercially pure



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Fig. 3 (left). Polished aluminium parts emerging from the 300-gallon Phosbrite bath at Haynes, Ford and Elliot Ltd. The daily throughput averages about 3,500 sq. ft. surface area and includes both S.P. and commercial-purity aluminium.

aluminium, a typical electrolyte being based on phosphoric acid and alcohol mixtures. While such processes will not achieve such high specular reflectance as the brightening processes, it must be appreciated that the finish obtainable with the latter depends greatly for its quality on efficient mechanical prepolishing.

So far as the general demands of industry are concerned, perhaps the most important result of the development of chemical polishing solutions is that they have provided a simple method of producing bright, attractive surfaces on almost all types of aluminium and its alloys. They polish S.P. aluminium and its alloys more simply and cheaply than electrolytic methods, and also polish commercial grades, particularly manufactured parts, which, because of their intricate shape, are beyond the scope of mechanical polishing.

Hitherto however, some chemical polishing solutions have been comparatively limited in scope. For example, one of the most widely used chemical polishing solutions contains mixtures of phosphoric, sulphuric and nitric acids in an approximate ratio of 70—20—10 per cent v/v. The solution produces bright surfaces on many grades of aluminium but has poor smoothing properties, so that surfaces tend to have fair reflectivity with a poor specular component. Again, nitric-acid/fluoride-based solutions are for the most part used only on high-purity aluminium and certain of its magnesium alloys.

The development of Phosbrite 159 is an attempt to produce a solution capable of achieving a high reflexion factor and S/T ratio (ratio of light specularly reflected to the total reflected by a sur-



Fig. 4. (below). General view of the Phosbrite plant at Metal Finishes Ltd. The bath has a working capacity of 110 gallons and an average daily throughput of 1,000 sq. ft. surface area all of which is commercial-purity aluminium. (Courtesy of Metal Finishes Ltd.).

face) on most grades of aluminium and its alloys, except high-silicon-content die-casting alloys. The basic aim in view has been to enable outworkers to use a single polishing bath for all, or almost all, their aluminium work where previously they had been using two or more perhaps entirely different techniques.

Fig. 5 (right) PVC extraction and scrubbing equipment on the plant at Metal Finishes Ltd. (Courtesy of Metal Finishes Ltd.).

Fig. 6 (below) "Ace" wheel disc after chemical polishing and anodizing. (Courtesy of Haynes, Ford and Elliot Ltd.).

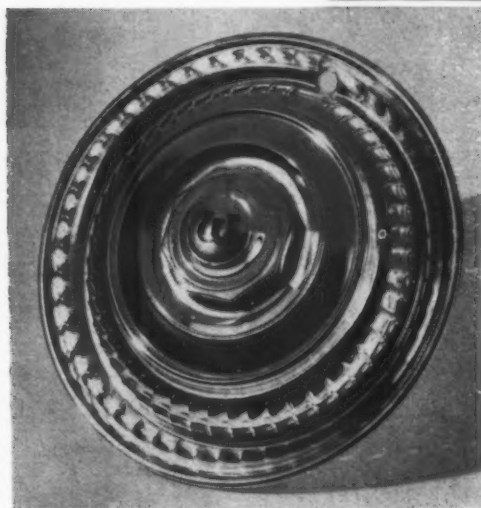


TABLE I.

Type of Metal	S/T Ratio	Total Reflexion Factor
Super purity (99.99 per cent.) (B.S. 1470/S1)	0.985	0.892
Commercial purity (B.S. 1470/S1C)	0.975	0.878
Alloy containing 1.25 per cent. manganese (B.S. 1470/NS3)	0.981	0.868
Alloy containing approx. 0.5 per cent. each silicon, magnesium and iron (B.S. 1470/H9)	0.952	0.895
Alloy containing 4 to 5 per cent. copper (B.S. 1470/HS15)	0.990	0.880

### Properties of the Process

Table I gives an indication of the performance of the solution, in terms of specularity and total reflectivity, on a variety of aluminium and alloys.

Phosbrite 159 produces bright and highly reflective surfaces in 2 to 5 minutes depending on the type of alloy and its surface condition. In contrast with some electropolishing processes (and many other chemical polishing solutions), it can often be used on super-purity and commercial aluminium which has not been mechanically prepolished. It removes heavy scratches and other imperfections from the metal. It should be mentioned, however, that on occasions mechanical prepolishing is used before chemical polishing, the effect of this treatment being to reduce the chemical polishing time and, thus, to extend the life of the bath.

Continuous production with Phosbrite 159 can be maintained over long periods without total renewal of the solution. Nitric acid is added to the bath in quantities determined by a simple test, while new solution is added to make good loss by drag-out. Processes of this type are sometimes criticized because drag-out losses may be heavy, due to the viscosity of the solution. In fact, if kept within reasonable limits, such drag-out is not necessarily a drawback since it helps to maintain the aluminium content of the solution below the critical concentration.

Chemical polishing processes have decided advantages over other methods in cheapness and simplicity of operation. Smaller firms of outworkers, for instance, are often discouraged from installing electropolishing plant because of the high first cost of the equipment; on large-scale



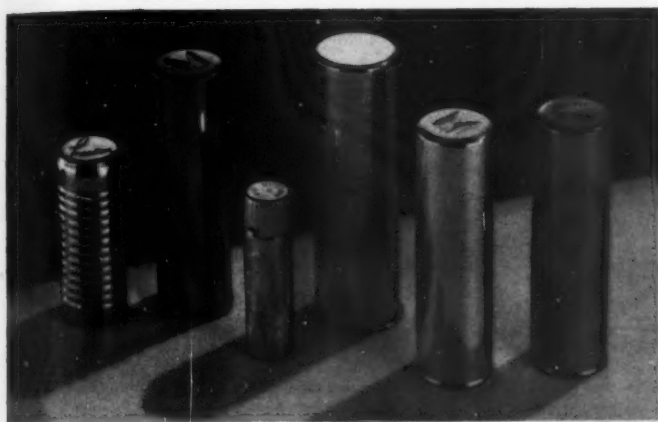


Fig. 7 (left) Cosmetic containers after chemical polishing, anodizing and dyeing. (Courtesy of Alumilite and Alzak Ltd.).

Fig. 8 (below). Phosbrite plant at Acorn Anodizing Ltd. The bath has working capacity of 300 gallons. On the left is the rinse tank. (Courtesy of Acorn Anodizing Ltd.).

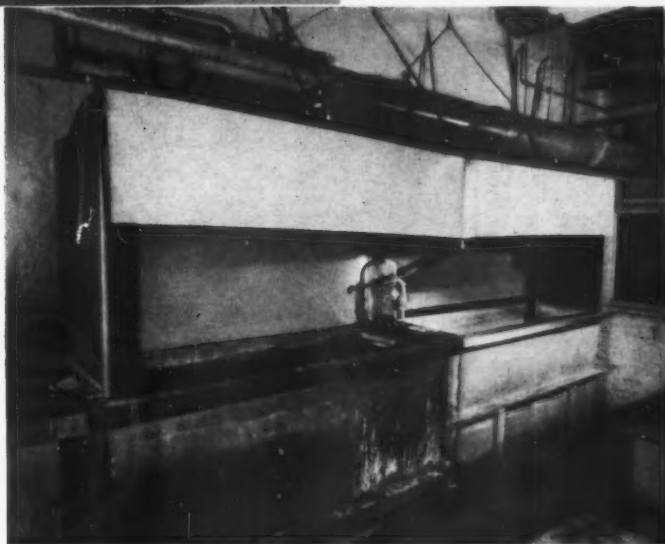
work it is often difficult to adapt electropolishing methods to fit in with the requirements of the production line. The first cost of chemical polishing is restricted to the price of the tanks.

The complete polishing schedule for Phosbrite 159 is as follows :

1. Immersion in polishing tank at 100°C. for 2 to 5 minutes.
2. Hot water rinse at 60 to 70°C.
3. De-smudge.
4. Cold-water rinse.
5. Hot-water rinse at 60 to 70°C.

The metal must be clean and dry before immersion in the polishing solution, and during polishing slight agitation is necessary to prevent gas streaking. The first rinse removes the viscous layer formed on the metal surface during the action of polishing. De-smudging takes about two minutes or less, the recommended solution being 50 per cent. v/v nitric acid at room temperature, though other solutions are also used.

The polishing tank should be of molybdenum- or columbium-stabilized stainless steel, and may be heated by stainless-steel steam coil or suitably sheathed immersion heater. The hot-water rinse tank should be of stainless steel or lead-lined mild steel, with the same method of heating as above. Fume-extraction equipment (preferably of PVC), is necessary on the polishing tank, and is also recommended on the hot-rinse tank. In most installations, the polishing tank and hot-rinse



tank are lined up end-to-end, the extraction and scrubbing equipment dealing with fume from both baths.

### Applications for the process

At present, by far the largest application for Phosbrite 159 is the treatment of a very wide variety of domestic equipment made from aluminium. In most cases, electrobrightening is unsuitable because commercial aluminium is used ; mechanical polishing to an acceptable standard would be difficult or impossible due to the complex shapes of much of this equipment. In almost every case, the polished metalwork is anodized and is frequently dyed.

Many outworkers operating the process treat domestic holloware such as kettles, saucepans and similar articles. Small articles of complex shape



Fig. 9.—The centre ashtray is shown before polishing. The other two have been polished, anodized and dyed in two different colours. (Courtesy of Reginald Corfield, Ltd).

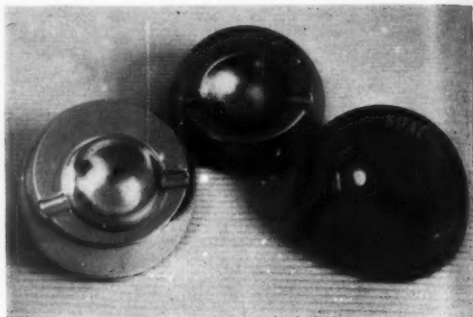


Fig. 10.—Ashtrays. (Centre) before polishing, (left) after polishing and before anodizing, (right) after anodizing and dyeing. (Courtesy of Serva Ltd.).

which can be polished in large number include watch and clock cases, metal buttons and badges, pen caps and components, cigarette holders, reflectors, knitting needles, etc. Another important category in the domestic field is parts for household appliances; these include ice trays and shelves for refrigerators, and trim on washing machines, vacuum cleaners and polishers.

The other major application for the process at the present time is on decorative trim which is replacing chromium-plated brass and steel in many industries. Chemically polished aluminium is being used on motor cars and aircraft for such parts as decorative strips, window frames, radiator grilles, wheel discs and luggage racks. Phosbrite 159 is also used for treating aluminium in the building industry, such as shop fittings and decorative panelling; future applications in this industry will almost certainly include window frames and even structural metalwork.

#### Some existing installations

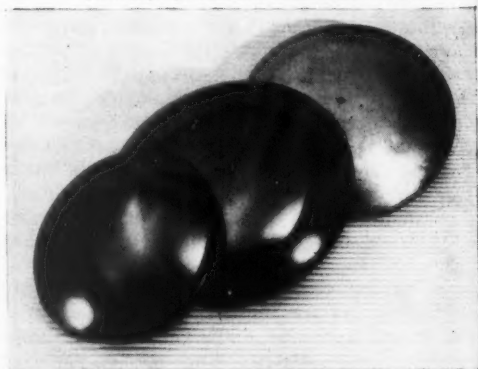
The work of the organizations whose plant and products are illustrated in this article reflects closely the present scope of the process as noted above. Some of these firms are large and include a variety of metal treatment processes — including electropolishing — amongst their activities; others confine their aluminium polishing work to chemical processes only, and in a number of cases Phosbrite 159 has replaced electrolytic polishing. In almost every case, the metalwork going through the Phosbrite tank includes both S.P. and commercial aluminium. Incidentally, the purchase of the polishing solution conveys a free licence to operate the process in this country under British patent.

Alumilite and Alzak Limited, of Merton, S.W., are one of the largest firms of outworkers in the country and operate a variety of metal finishing processes at their works. They have a considerable throughput of S.P. aluminium, and for special

work requiring the highest possible specular reflectance on plane surfaces use their well-known Alzak electrolytic process. At present they run two 250-gallon Phosbrite tanks, that contain the newer solution being used for polishing the S.P. aluminium. The great majority of work, however, is commercial aluminium of about 99.5 to 99.8 per cent. purity, which includes ash trays, lipstick and other cosmetic containers, saucepan lids, kettles, knitting needles and reflectors for lamps. Only the lids and kettles are mechanically prepolished, while most parts are anodized and dyed after chemical polishing. Before entering the Phosbrite tank the parts are degreased in trichloroethylene or hot acid, and the parts are desmudged in a nitric-acid solution.

Aluminium Anodizing Limited, of Turnmill Street, E.C., concentrate almost exclusively on small parts, including costume jewellery for multiple stores. This is fabricated (and in some cases designed) by the company, which also designs, (Continued on page 26)

Fig. 11.—Holloware lids before and after polishing, anodizing and dyeing. (Courtesy of Alumilite and Alzak Ltd).



## Developments in

# SWEDISH ELECTROPLATING PRACTICE

## during the Past Two Years

by G. JONSSON\*

(A Paper presented to the Distributors' Conference organised by the Electro-Chemical Engineering Co., Ltd., at Weybridge, October 2, 3 and 4, 1957).

**A**LTHOUGH no revolutionary developments have taken place in Sweden or its neighbouring countries during recent years, it is hoped that this short survey will give an idea of how a small country, with generally limited production runs has tried to adapt modern electroplating methods and machinery to suit its needs.

As in most other countries production has increased in Sweden but so also has the shortage and cost of labour. This has naturally led to an increasing interest in labour-saving equipment and processes for electroplating. Shortage of money and rigid government restrictions on credit have however in many cases been a drag on progress.

### Equipment

There are in Sweden about fifteen fully automatic plating machines, most of them of German origin. One of these machines is installed at a refrigerator factory and is used for zinc, copper, nickel and chromium plating of shelves and baskets made of wire. Another automatic machine has been delivered to a manufacturer of calculating machines. In this case the customer wanted a machine which could perform almost everything including delayed setdown, take-up after half the passage through the nickel tank, by-passing the chromium tank etc. All this can be done by setting a dial on the rack carrying arm. It is not known whether the customer gets a machine which really can perform all these functions but the equipment is mentioned because similar demands are being made by several Swedish firms. Their production is limited and they cannot afford to buy several automatic plating machines; they are therefore looking for very versatile machines which can be adjusted to suit various plating specifications.

Early this year the author's company delivered the first Efco-Udylite "Junior" fully automatic plating machine to be built in the works. The machine is made for the bright nickel plating of

vacuum-cleaner parts and is installed in a factory in Copenhagen, Denmark. It is the first and only fully automatic plating machine in Denmark. Fig. 1 is a photograph of the machine taken during mechanical test in the works and shows the machine with control panel, filtering unit and purification tank. Attention is drawn to the fact that the superstructure has been steadied by beams from the outer rim of the tank. It is believed that this is a good idea, especially if the load on the racks is near the maximum, and the general appearance of the machine does not suffer very much. The erection of this machine at the customers works took less than a week and the machine has been in full and troublefree operation ever since it was started up.

Fig. 1.—Swedish-built Efco-Udylite "Junior" installation.



\*A. B. Tudor, Sweden

Fig. 2—(right) Cleaning machine and semi-automatic plating conveyor.



Fig. 3—(below) Close up view of cleaning installation.



In process of erection in the works and soon ready for mechanical testing is an extended "Junior" zinc plating machine. This machine will be about 14 metres (46 feet) long and is intended for bright zinc plating followed by a passivating bright dip. Since a delayed set-down mechanism is hard to incorporate in a "Junior" a special chromate dip with delayed action has been put in and the leaching will probably be done in hot water instead of in alkalis or reducing agents.

Production runs in Sweden are generally not very large. A firm can have a rather big volume of, for instance, nickel plated articles in an eight-hour shift but this production is split between a very wide variety of articles ranging in size from small vending machine parts up to bicycle parts, tubular furniture or even automobile bumpers. In such cases mechanization of the plating operations can be rather difficult. A fully automatic plating machine capable of handling the tubular furniture will be too large and expensive and a machine designed for handling the smaller parts will have racks and tanks too small for the larger articles; it will be necessary therefore to install a large, manually operated plant for plating these articles.

In such cases the trend in Sweden is to make a compromise and install a combination of fully automatic and semi-automatic plating machines. Figs. 2, 3, 4 and 5 illustrate this principle.

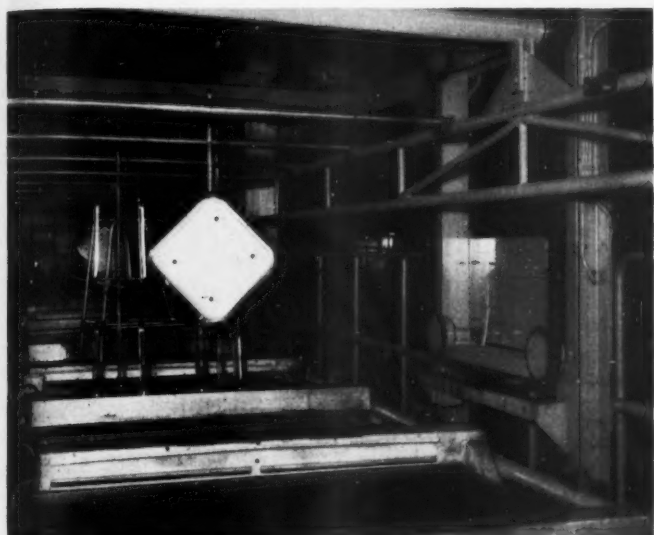


Fig. 4—(left) Components being processed in cleaning installation.



Fig. 5—(right) Plating installations with cleaning machine and two semi-automatic lines.

In Fig. 2 is shown a fully automatic cleaning machine to the right and a semi-automatic plating conveyor to the left.

The cleaning machine is of the straight-through transfer type and automatically performs the following operations :

1. Cathodic cleaning (2 stages).
2. Water rinse.
3. Anodic cleaning.
4. Water rinse.
5. Acid dip.

6. Water rinse.
7. Copper strike.
8. Water rinse.
9. Acid dip.
10. Water rinse.

After passing through the cleaning machine the racks are manually transferred to the semi-automatic plating machine for bright nickel plating in a 514 type bath. After about 40 minutes of bright nickel plating the racks are removed from the semi-automatic and rinsed and manually



Fig. 6—(right) Straight line fully automatic plating machine.

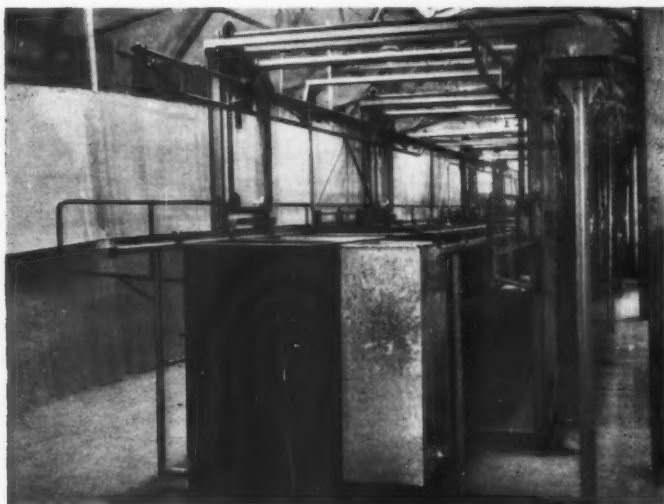
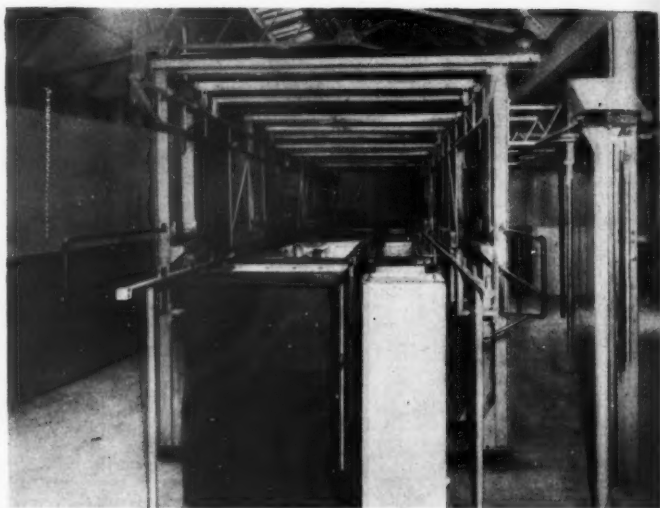


Fig. 7—(left) Another view of the machine shown in Fig. 6.

chromium plated in a bath containing Zero Mist. The chromium plating tank is not fitted with exhaust ducts or fans.

Fig. 3 shows the cleaning machine in some detail and with the racks in "up" position; the work being processed consists of bumper guards. Fig. 4 shows a close-up of the machine, the work being parts for tubular furniture.

A very wide variety of goods can thus be handled by the machine and the customer has found that his investment is very well justified, the labour cost having been halved. With the earlier manual plant the cost was 10.35 öre per piece in labour, but in the modernized plant this cost is cut to 5.40. This means that by modernizing the plant

the cost of labour has been reduced by 50 per cent. (from 2d. apiece to 1d.).

The same principles as are used for the mechanical transfer units just described have also been employed in the construction of fully automatic plating machines of the straight-through type. Figs. 5, 6 and 7 show a machine of this type. The machine is designed for three rows of work, two rows being used for bright nickel and chromium plating. The third row was originally intended for nickel plating followed by silver plating but is now being used for copper plating. The articles being processed are trays and plates made of polished and buffed brass. Nickel plating is done in a 322 H type solution and chromium plating



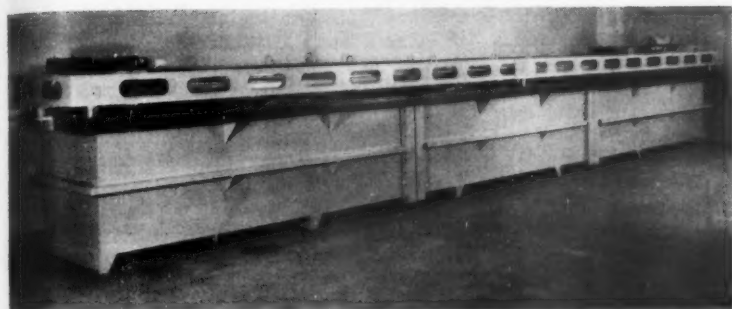


Fig. 8—(left) Etching tank for heavy nickel plating.

in a S.R.H.S. type solution containing Zero Mist. The chromium plating tank is therefore not provided with any exhaust equipment. Return of racks and cathode bars from the unloading end to the loading end are by means of a light chain conveyor along one side of the machine, which has a total length of about 70 feet. The lifting frame has the same length as the machine but is not in the form of a straight line. Where lateral transfer of the racks is required, as in the cleaning, nickel plating and chromium plating tanks, the lifting frame has a lower portion which only can contact the cathode bars when the lifting frame is in the "up" position. Hence no lift occurs until the cathode bars have been moved through the tanks, and are ready to be transferred to the next processing tank. Because all transfers are made by one rigid frame extending all the way through the machine all movements are by necessity synchronous. The mechanism is driven by one single electric motor and the plating machine is therefore uncomplicated and can be built at a very reasonable price.

In the later part of 1956 the author's company made an interesting installation for heavy nickel plating. Part of this is shown in Figs. 8 and 9, as it is not possible to obtain a complete view of the plant. Among articles to be nickel plated in this plant are steel tubes about 30 ft. long and 1 ft. in diameter. These tubes have to be plated on the outside with a minimum of 0.004 in. nickel, and the process sequence is as follows:

1. Alkaline cleaning.
2. Water rinse.
3. Anodic etch in strong sulphuric acid.
4. Water rinse.
5. Nickel plate.
6. Cold-water rinse.
7. Hot-water rinse.
8. Drying in hot air.

The main problem in this plant was the anodic etching. A tube 30 ft. long and 1 ft. diameter has a surface area of about 280 sq. ft. As the current density needed for a clean job on the grade of steel in question was of the order of 200-

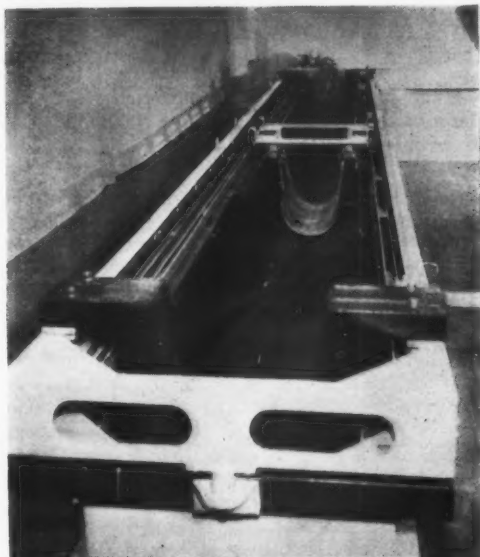


Fig. 9.—(above) Moving cathode in an electrolytic etching tank.

250 amp. per sq. ft. the total current for anodic etching would be something like 55,000 to 70,000 amperes. This is far too much to handle in a plant such as this and the problem had to be solved along new lines. The method can be seen partly from the illustrations. A special fixture consisting of a heavy frame is used, in which the tube is arranged so that it can be continuously kept in rotation by an electric motor via gear wheels of plastic material. The cathode is made of very thick lead and is attached to a superstructure with rollers which are fastened to an endless chain which moves the cathode longitudinally along the tube. The speed of rotation of the tube and the speed of longitudinal movement of the cathode are co-ordinated so that overlapping occurs. The cathode is thus moving along the tube as this is rotating and limit switches at both ends of the

cathode track automatically reverse the direction of travel of the cathode so that it makes the required number of passes to achieve a perfectly clean and properly etched surface.

In the nickel plating tank the tube is continuously rotated between "still" nickel anodes.

For the time being no chromium plating is required on the tubes, but if the need arises, we feel confident that the same principle with a moving electrode could be adopted. Instead of using something like 60,000 amp. this plant uses only 5,000 amp. for anodic etching. The nickel solution used for nickel plating of the tubes is the "soft" solution described in detail in A.R.D. Electrodeposition Memorandum No. 2.

### Plating Processes

With regard to electroplating processes there is little of great news value to be reported from Sweden.

It is, however, of interest to note that a zinc undercoat on steel is receiving extended use. It is now about ten years since the author's company were asked to offer semi-automatic equipment for the plating of steel refrigerator shelves with zinc, copper, bright nickel and chromium. Three semi-machines were automatic installed for zinc plating, bright nickel plating and chromium plating. No machine was needed for copper plating since this only had a duration of about one minute. All rinsing and acid dipping between plating operations was done by hand. After ten years of practical experience it must be said, that this system of rustproofing refrigerator shelves has been a success.

The process sequence now used in a fully automatic plating machine is as follows:

1. Alkaline soak clean.
2. Water rinse.
3. Cathodic pickling in strong sulphuric acid.
4. Water rinse.
5. Anodic etch in strong sulphuric acid (1.100 gm. per l.).
6. Double water rinse and spray.
7. Bright zinc plating.
8. Double water rinse.
9. Dip in 1/4 to 1/2 per cent. nitric acid (5 seconds).
10. Water rinse.
11. Alkaline copper flash.
12. Double water rinse.
13. Bright nickel plating.
14. Double water rinse.
15. Chromium plate.
16. Double water rinse.
17. Hot-water rinse.
18. Hot-air drying.
19. Load and unload.

The zinc coating has a thickness of 15 to 20

microns, the nickel coating a thickness of 12 to 15 microns and the chromium coating a thickness of about half a micron. The intermediate copper layer between the zinc and the nickel has a thickness of only about one micron. The racks must therefore be "live" while entering the bright nickel solution, as otherwise the thin copper coating may dissolve before any nickel is deposited and black streaks can result. The copper layer has either to be very thin (*i.e.* about 1 micron) or rather thick, say 8 to 10 microns, to be successful.

Bright nickel plating is being done in an Efcodylite solution of the No. 31 type. Although so much zinc is being plated in the bath, no serious troubles with zinc contamination have been encountered during all the years the bath has been in operation.

The good corrosion resistance and excellent appearance of the finish has led to the adoption of the combined zinc, copper, nickel and chromium deposit by several firms in Sweden who produce wire goods. There are many so called "super markets" in Sweden and in this special field, display and carrying baskets are increasingly finished in this manner. This is an example of how an electroplated finish competes successfully with a dipped plastic finish. Interesting tests on this type of finish are also being made on other types of products, for example on parts for household washing machines provided that these are not continuously exposed to the action of the washing solution. Tests are also being carried out by automobile manufacturers, and there is confidence that these tests will show good results from the corrosion protection angle. Bumpers have been plated in this manner for company cars and on cars belonging to friends and the finish has, as far as can be judged, stood up considerably better than the usual nickel and chromium, or copper, nickel and chromium finish.

The author's personal feeling is, therefore, that in the years to come much more will be heard about this type of finish. It should be remembered however, that this system is not the same thing as plating on a zinc die-cast surface, in which there are so many factors that are out of the platers control, such as alloy composition, cooling, polishing and buffing methods etc. When the original zinc surface is electroplated however, there is in fact an almost chemically pure zinc to deal with, and this makes all the difference. Pure zinc will not even dissolve in hydrochloric acid unless it is touched with a wire or a piece of another metal to start the reaction.

It is probable that zinc will be used extensively as an undercoating on automobile bumpers instead of nickel or copper and nickel which has been more or less standard in the past. A trend in

(Continued in page 26)



## A Quarterly Survey of some of the Features in Finishing Literature from Abroad by SCRUTATOR

IN recent months considerable interest has been shown in the use of cadmium, either alone or as an alloy coating, for the protection of steel against corrosion. For example, some details have been given<sup>(1)</sup> of diffused nickel-cadmium deposits for preventing the corrosion of carbon and low alloy steels which may have to operate at temperatures up to 900°F. Treatment consists of nickel plating using a nickel sulphate or nickel chloride bath, after which the components are rinsed, neutralized in alkali and transferred directly to a cyanide cadmium plating solution. The thickness of the cadmium deposit should be not more than half that of the nickel and cadmium thicknesses of 0.0001 in. are claimed to be adequate for producing a good diffused condition. Diffusion is carried out by heating at 630°F. for 30 minutes — 1 hour, after which the parts must resist heating in air at 700°F. for 23 hours followed by heating at 1000°F. for 1 hour without blistering or cracking on significant surfaces. Further, they should show no corrosion after 100 hours salt spray testing. Cohen<sup>(2)</sup> has also described a variety of corrosion tests on electrodeposited 73 per cent. cadmium — 27 per cent. tin and 62 per cent. zinc — 38 per cent. tin alloys on steel. These showed that the cadmium alloy was superior to cadmium under salt spray test, slightly better in high humidity conditions and equal in galvanic effect upon aluminium and magnesium alloy in high humidity conditions. The zinc-tin coatings were inferior to both cadmium and the cadmium-tin alloy in these tests. In additional experiments the cadmium-tin alloy proved superior to cadmium for corrosion protection in jet fuels containing mercaptans, in high temperature synthetic alloys and in the presence of the vapours from aqueous solutions of acetic acid. It was easily solderable using methods normally employed for cadmium and at cold temperatures the tin-rich phase was not converted from white to grey tin.

Hydrogen embrittlement is one of the potential hazards which may arise from cadmium plating in cyanide baths and the Lockheed Aircraft Corporation<sup>(3)</sup> have recently reported upon three techniques which they have investigated for producing protective cadmium coatings with the minimum chance of embrittlement. These comprise (a)

Maintaining the current density at 60 amp. per sq. ft., or more. This results in a slightly more porous electrodeposit but hydrogen can be more easily removed on baking. (b) The addition of nitrates to the cyanide bath to suppress hydrogen formation. Traces of organic agents are also included to maintain throwing power and covering properties. Good results are claimed although few details are given. (c) Vacuum metallizing for which it is claimed that the corrosion resistance of the coatings compares favourably with that of electrodeposits!

### Electroplating

Dow and Bakker<sup>(4)</sup> have shown that copper can be determined in a copper cyanide plating solution by electrolytic analysis with an accuracy of about  $\frac{1}{2}$  per cent. The total time for the procedure is approximately 75 minutes of which 1 hour is taken up by the electrolysis. Another interesting method is that described by Doherty<sup>(5)</sup> for the spectrophotometric determination of nickel (and hence brighteners) in bright cadmium and bright gold plating solutions. A Spectronic 20 colorimeter was used for measuring the colour transmission of the coloured nickel complex produced with dimethylglyoxime and 2½ years experience as a routine control method showed the accuracy to be  $\pm 10$  per cent. It is not intended as a highly accurate quantitative method.

### Coatings

A number of new materials are slowly finding favour in the American architectural field and these include vitreous enamelled aluminium, plastic covered steel or aluminium, and anodized and dyed aluminium etc. The latest of these to be announced<sup>(6)</sup>, which by British standards at any rate sounds somewhat expensive, is blue porcelain enamel on textured stainless steel. The stainless steel gives rigidity and flatness and the easy-to-clean enamel has excellent colour stability and scratch resistance. The material is made up and used in the form of a  $\frac{3}{8}$ -in. thick sandwich consisting of the enamelled stainless steel sheet, an aluminium honeycomb and an electrogalvanized

(Continued in page 23)



# THE FINISHING POST

A SELECTION OF  
READERS' VIEWS COM-  
MENTS AND QUERIES  
ON METAL FINISHING  
SUBJECTS . . . . .

Advice on all aspects of metal finishing practice is offered on these pages, and while every care is taken to ensure the accuracy of information supplied no responsibility can be accepted for any loss which may arise in respect of any errors or omissions.

## Proprietary Processes: the Need for Secrecy.

Dear Sir,

I have read with interest the editorial entitled "Formulae, Fears and Facts" in the December number of the *Metal Finishing Journal*. I have seen references in the Press on this subject on previous occasions and I am writing this letter to you because I believe the subject is an important one and because it has more aspects than are presented in your editorial.

There are, I believe, some misconceptions which become accepted as a result of frequent repetition and which contribute nothing to the solution of the real problems.

As the Research Associations, in many cases financed in part by Government funds, are well aware, the cost of research and development work is high, and whereas such Associations can look to Industry and the Government for funds to support their work, suppliers of metal finishing processes are dependent exclusively on the profits which can be made from the sale of their products.

The user of a proprietary process will inevitably expect free service from the supplier, even when, as frequently happens, the cause of the defect is entirely the responsibility of the user. I can recall a large number of cases, such as the customer who added trisodium phosphate to a large nickel tank in mistake for boric acid, and the other customer who consistently adjusted the pH of the nickel plating solution with phosphoric acid in mistake for sulphuric. It is normal in these circumstances to attribute the fault to some defect in the brightener system and the suppliers' technician is left with the task of discovering the trouble and rectifying it in order to establish the fact that the brighteners were not at fault. The suppliers of proprietary processes accept this as part of their business and do not complain, neither do they as a rule make a charge for this service. Bearing in mind their defects, which are so frequently quoted in this respect, perhaps it will be admitted that they compare favourably with other sections of industry; how many garages will provide free service and replacements for their customer who, with equal

oversight, puts water instead of oil into the sump of his motor car?

Various attempts have been made to overcome this problem by separating the cost of service from the cost of the product, but it is a fact which no-one involved in the commercial side of the metal finishing business would dispute that nobody wants to pay either a separate royalty under a patent or a separate charge for service. More than one good process has failed to be adopted commercially because its proprietors have attempted to exploit it in the wrong method. The suppliers of metal finishing processes must, therefore, realise that they have substantial overheads in the way of research, development and service charges which must be met from the price of the products they sell.

I believe that suppliers of metal finishing processes are not, as you suggest, concerned about the jobbing plater or painter who would have a chemical laboratory of his own, but are more concerned about the unscrupulous competitor in this country and abroad who, being in possession of the formulation of the addition agents, but without the overheads resulting from the research, development and service costs, would be in a position to supply addition agents at prices below the costs of the inventors. Such a step could only result in further curtailment of the existing research and development which, as you rightly say, is already inadequate.

I am not aware how much thought you devoted to the matter before you said that the constituents of these processes cannot be kept secret for more than a few days. One of the major reasons for secrecy on the part of the suppliers is in fact the extreme difficulty in analysing some brightener mixtures and, consequently, in determining whether patents are being infringed. The temporary monopoly granted by Parliament to the inventor of a new process was intended to reward him for disclosing to the public details of this process after the patent expired. Unfortunately, so difficult can the analysis of some of these products become, that the publication of a patent not infrequently acts as a signal to a competitor to produce something infringing the patent, relying on the difficulty of the analysis as a safeguard. It appears to me that the publication by the Patentee of the specific

(Continued in page 19)



## Sudden Death of ALASTAIR McLEOD

The very large number of readers of this Journal who counted Alastair McLeod, its managing editor, among their personal friends will have learned with regret of his sudden and untimely death on January 3. Mr. McLeod was taken ill at his desk and underwent an immediate emergency operation from which he failed to recover. He was 58.

Although his principal activities lay in steel-making and rolling circles, Mac, as he was universally known, played no small part in the metal-finishing industry, his services to the Institute of Vitreous Enamellers, in particular, being recognized only last year by the award of an Honorary Life Membership.

Although his movements were increasingly hampered by rheumatism, which caused him considerable physical pain, Mac's many interests led him to travel widely and he was almost as familiar a figure at meetings of metallurgical bodies in Europe and Scandinavia as he was in this country.

In spite of the pain he suffered he was at all times a cheerful and colourful personality whose advice and guidance was widely sought and freely forthcoming.

In recording our own deep regret at his passing we extend to Mrs. McLeod our sincere sympathy.

### Finishing Post

(Continued from page 18)

formulations selected would have only one consequence, namely, an increasing number of infringements and a further deflection of effort from new research and development work towards the maintenance of patents already in force.

I would like to turn now to another function of the supply house which is also rarely acknowledged: it is that of taking a process from the laboratory stage, through pilot scale operations and the early stages of commercial use. It is a fact that the majority of Companies using metal finishing processes or products have considerable inertia and will not change their processes without persuasion. One has only to consider the new metal finishing processes or products which have been adopted during the past twenty years to realise that the majority of them saw their origin from one or other of the supply houses.

A number of promising processes have been developed by Research Association but have received little commercial adoption. I suggest that there are two main reasons for this: first, that the problems resulting from a transfer of a process from the laboratory to the full production scale, either in respect of equipment, contamination or purification, have not been adequately solved, or, secondly, because it is not worth anybody's while to acquire the practical experience without which these processes are of little commercial value. I could name a dozen apparently promising processes which have never gone very far beyond the pages of a technical journal for these reasons.

Finally, if there is trouble with an electro-plating solution, how much will it help the foreman plater to that that the brightener consists, if I may quote U.S. Patent 2,198,267, of . . . "Naphthalene sulphate and an amino polyaryl methane compound

in which at least one amino group is attached to an aryl group" ?

I believe that the supply houses should publish sufficient and adequate instruction to enable the users to perform control analyses and recommendations as to the action which should be taken if specific troubles are encountered; that they should preserve a high standard in the manufacture of their addition agents and continue as they do at present to give a free service to their customers irrespective of who is responsible for the trouble. This policy, in conjunction with free competition between the suppliers of different processes, should ensure that new processes continue to be released to industry and the manufacturers are able to continue and expand their research and development programmes.

I would respectfully suggest that there are dangers resulting from the attitude of mind which your leading article discloses. There is frequently a tendency to blame organic addition agents of a proprietary nature for faults which are in fact attributable to nothing more than bad housekeeping or a failure to comply with the clearly published instructions of the manufacturers. In support of this view I would point to the widely held belief that organic bright nickel processes were responsible for much of the poor nickel and chromium plating which has been done since the war. It has taken the recent excellent work of the B.N.F. Research Association to show that this belief was without any foundation, and the more users are encouraged to concentrate on the irrelevant the less attention will they pay to the much publicised essentials.

Yours faithfully,

A. SMART.

Electro-Chemical Engineering Co. Ltd.,  
Sheerwater,  
Woking, Surrey.

## Some Comments on

# THE ANODIC OXIDATION OF ALUMINIUM ALLOYS containing COPPER

By J. HÉRENGUEL\* and P. LELONG\*

**A**NODIC oxidation of aluminium alloys containing copper is known to present a number of complications and difficulties which are not encountered with aluminium itself or with the Al-Mg alloys.

The practical difficulties met with in the two-phase alloys are well known and are summarized below. On the other hand the details relating to solid solutions are worthy of further study. Some new aspects of this subject are discussed here, and in particular the little known phenomenon of the yellow coloration of the anodic films observed on the homogeneous Al-Cu solid solution of high purity.

When the copper is not entirely in solid solution, the compound  $\text{CuAl}_2$  which it forms with aluminium is violently attacked during anodizing. During solidification from the melt, this compound segregates at the grain boundaries and between the branches of the dendrites; during anodic oxidation these are areas of preferential attack. Fig. 1 shows this effect on a section of an Al-4 per cent. Cu alloy in the as-cast condition.

This intergranular and interdendritic attack has the following disadvantages:

If the copper content of the alloy is 4 per cent. or more the depth of the attack is sufficient to have

a significant effect on the dimensions of the components.

There is a marked increase in the actual surface area being treated, leading to a considerable increase in current consumption with no equivalent rise in the efficacy of the process.

Electrolyte is retained in the intergranular cavities leading to corrosion later and to difficulties in dyeing of the coating. All these disadvantages are well known and have been described in detail by one of the present authors.<sup>(1)</sup>

Disadvantage of a similar nature, but less acute, are found with Al-Cu solid solutions in the heat treated condition. The selective precipitation of particles of  $\text{CuAl}_2$  leads to the same sort of attack as in the as-cast condition, although the small size and the separation of these particles generally reduces the degree. On the other hand if the grain boundaries have a continuous surround of precipitated particles, intergranular attack sets in and continues towards the inner layers of the metal. This is the "maillage" effect described by Lacombe<sup>(2)</sup> affecting the grain boundaries and sometimes the interior of the grains also.

## Difficulties Caused by Copper in Solid Solution

When the copper is in solid solution and homogeneously distributed throughout the alloy it still

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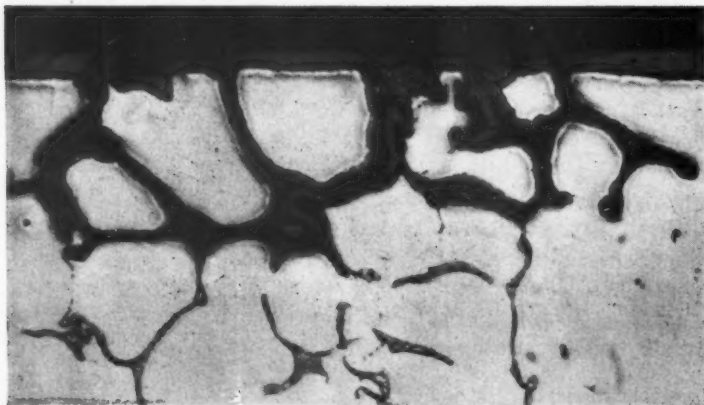


Fig. 1—Cross section of an Al-4 per cent Cu alloy structure as-cast anodically oxidized showing deep penetration due to selective attack on the  $\text{Al}_2\text{Cu}$  constituent (x 500)



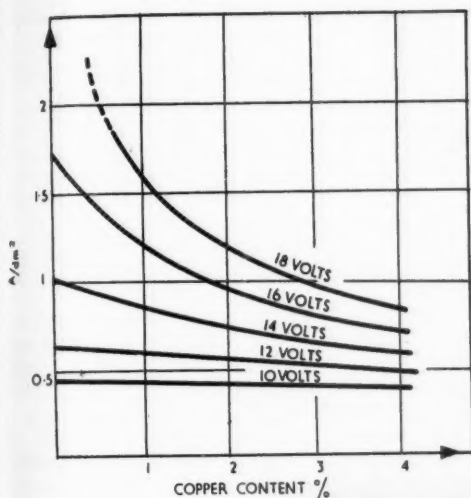


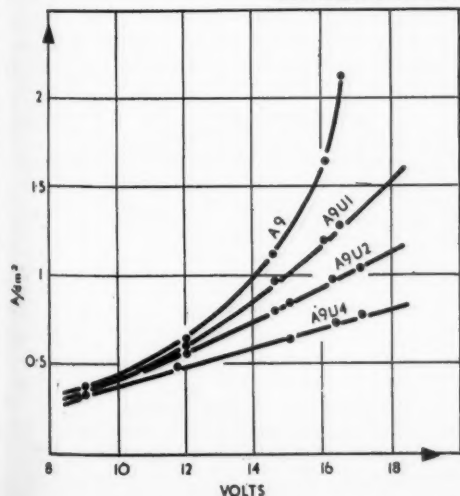
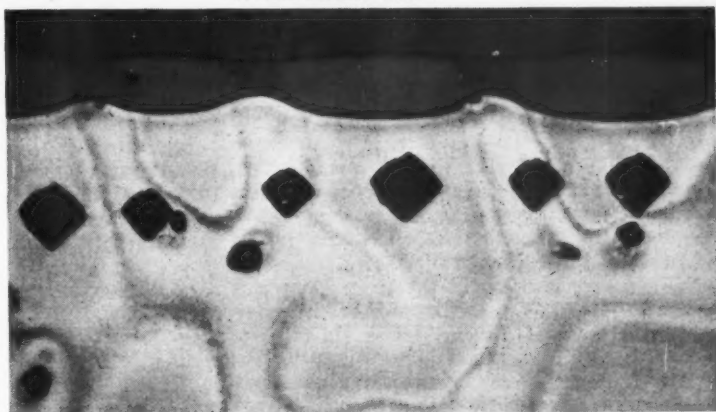
Fig. 2.—(left) Curves showing the effect of increasing copper content in an aluminium alloy on the current density of oxidation at various voltages. Anodized in sulphuric acid 180 gm. per l. at 20°C. with agitation.

gives rise to a number of special effects not shown by pure aluminium.

The speed of oxidation (or the current density) decreases markedly with increase of copper content for the same voltage. This phenomenon also has already been recorded.<sup>(3)</sup> Its importance has been measured with a high degree of precision on a series of Al-Cu alloys prepared from 99.99 purity aluminium containing from 0 to 4 per cent. of copper and perfectly homogenized by hot working. Fig. 2 shows the current densities obtained after treatment for five minutes in sulphuric acid solution of 180 gm. per l. at 20°C. at five constant voltages (10, 12, 14, 16 and 18 volts.).

Treatment in this classic electrolyte reveals several further facts :

Fig. 3.—(right) Cross-section of an Al-2 per cent Cu alloy with a non-uniform structure anodically oxidized. The variations in the thickness of the anodic film correspond to local differences in copper content revealed in the section by etching and micro hardness indentations  $\times 600$ .



At low voltages the speed of oxidation is virtually independent of the copper content. The "undulation effect" which results from non-uniform distribution of the copper is then more or less nullified. On the other hand at higher voltages the copper content is of increasing importance and the surface undulations become more and more marked. The section illustrated in Fig. 3 shows the importance of the undulations on an Al-2 per cent. Cu alloy oxidized for 30 minutes at 0.75 amp. per sq. dm. in an electrolyte containing 180 gm. per l. of sulphuric acid at 20°C.

As the copper content is raised so the influence of voltage on the speed of oxidation decreases. For example, with a zero copper content a rise in voltage from 10 to 18 volts raises the current

Fig. 4.—(left) Curves showing variations in current density as a function of voltage during the anodic oxidation of various Al-Cu alloys. Anodized in sulphuric acid 180 gm. per l. at 20°C.

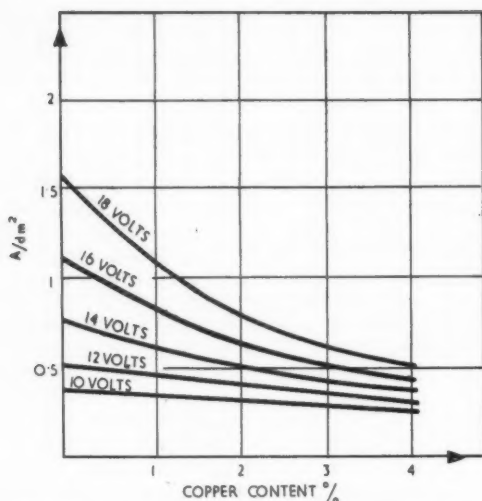


Fig. 5.—Curves obtained under similar conditions to those shown in Fig. 2 but at the lower temperature of 15°C.

density from 0.45 to more than 2 amp. per sq. dm. while with 2 per cent. copper content the same rise in voltage will only raise the current density from 0.42 to 1.15 amp. per sq. dm. With a copper content of 4 per cent. the phenomenon is even more clearly developed and it becomes almost impossible with such high copper contents to increase the speed of oxidation (See Fig. 4).

Similar curves are obtained when working at a temperature of 15°C. but the slope of the curves which are obtained, although similar to those in Fig. 2. is slightly less marked.

The range of current density and temperature over which it is possible to obtain a film of adequate continuity and compactness (with no soft layer on the surface) is narrow. Its limits have been established by R. Segond and one of the present authors, for an alloy of the type A-U4G (4 per cent. Cu, one per cent. Mg.) oxidized in an electrolyte containing 180 gm. per 1. sulphuric acid for 45 minutes.<sup>(3)</sup> Fig. 7. shows the limits within which it is possible to work as compared with those for pure aluminium; the range within which treatment is possible is considerably smaller for the copper alloy.

As a result of the particularities described it is difficult to produce on an Al-4 per cent. copper alloy oxide films of adequate compactness of a thickness greater than 10 to 12μ.

#### Coloration of the Oxide Film by Copper

An examination of samples of commercial alloys of aluminium containing 4 or even 4.5 per cent. of copper, whose structure is not perfectly homogeneous, frequently reveals after anodic treatment

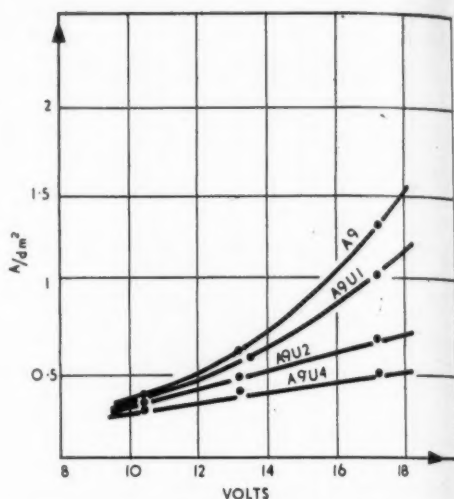
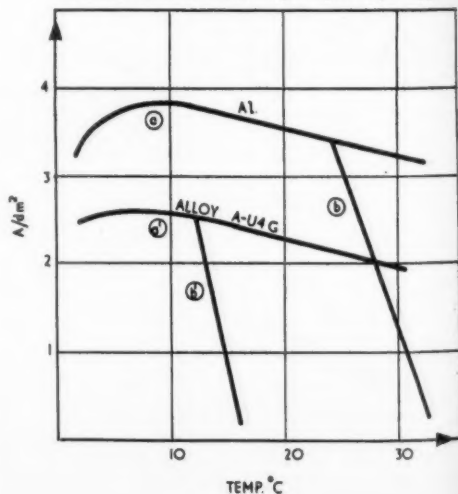


Fig. 6.—Curves obtained under similar conditions to those shown in Fig. 4. but at the lower temperature of 15°C.

in a sulphuric electrolyte that the oxide film is flecked with a rich brass colour. The coloured regions coincide with a very marked "undulation effect"; they occur more frequently when the current density used in the anodic treatment is relatively high for reasons which have already been stated. Work has been carried out

(Continued on page 23)

Fig. 7.—The lines indicate temperature limits within which it is possible to anodize an alloy A-U4G compared with those for un-alloyed aluminium. a and a' limit at which discontinuities appear in the film. b and b' limit at which a soft surface layer appears.



## Anodic Oxidation of Aluminium Alloys containing Copper

(Continued from page 22)

to determine whether this coloration of the film is specific to the presence of copper by anodically treating Al-Cu alloys which had been severely hot-worked and annealed to produce a completely homogeneous and uniform solid solutions.

The following observations have been made:

On all the homogeneous alloys containing copper a yellow coloration of the anodic film has been observed on treating in the sulphuric electrolyte, although pure aluminium gives clear and transparent films. The colour appears yellow, both by transmitted and reflected light (on a detached film) and is intensified when the copper content is increased for a given film thickness or when the film thickness is increased for a given copper content. With a copper content of 2 per cent. and a film thickness of  $12\mu$  for example, the colour is pale gold but certain additions to the sulphuric electrolyte can strengthen the colour as for example additions of nitric acid (2 to 4 per cent. by volume of 36° Bé nitric acid).

The coloured film when detached gives every indication of the presence of copper. When treated in a solution containing 50 per cent. of 22° Bé ammonia the film is de-colored in a few hours at room temperature and remains transparent. A similar effect is produced by 5 per cent. nitric acid.

Treatment in a dilute solution of ammonium sulphide causes a slight darkening of the film as does also a solution saturated with  $H_2S$  containing a trace of HCl.

Prolonged heating in air at 800°C. turns the film a pale green, while in vacuum ( $10^{-4}$  mm. of mercury) it becomes brownish. Further heating in air turns it back to green while re-heating in vacuum restores the brown tint.

It is probable that the film retains copper in a more or less oxidised form, probably a basic sulphate or oxide insoluble in the electrolyte.

Under the microscope the film appears transparent and homogeneous at the highest powers, so if the copper is present in particulate form the particles must be extremely small.

### Conclusion

The addition of copper to aluminium gives rise to a certain number of special features in anodic oxidation. When the copper is not wholly in solid solution (as-cast structure or precipitation treated) local attack is inevitable.

In solid solution, copper acts in the reverse way to magnesium, by hindering the mechanism of anodic oxidation and reducing its speed. It appears as if the presence of copper restrains

the progress of the electrolysis and causes an actual blockage.

The early re-attack at the electrolyte-film interface for a given temperature or current density may result from an increased electrical resistance of the film (thus causing a rise in temperature throughout the film thickness).

The rapid attack on  $Al_2Cu$  on the one hand and the early onset of attack on the oxide film surface on the other must not cause the fact to be overlooked that the presence of copper slows up the process of anodic oxidation of the solid solution itself. The resistance effect produced by the growth of the oxide film is supplemented by a specific effect arising from the presence of an insoluble copper compound. It would be particularly desirable to be able to dissolve such compounds during electrolysis which would make possible the treatment of Al-Cu solid solutions under conditions approximating to those of aluminium itself, that is to say with the same practical possibilities.

### Acknowledgments

This work was carried out at the Centre de Recherches d'Antony and the authors express their thanks to the Ste des Trefileries et Laminiers du Havre and the Cie Francaise des Metaux for having granted permission for its publication.

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2. Lacombe, P. and Morize, P., Metaux 19 (222) February 1944, pp. 30-35.
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### Overseas Reveil

(Continued from page 17).

mild-steel back-up sheet all bonded together by adhesive. According to Ostrander<sup>(7)</sup>, chromate conversion coatings for hotdip galvanized surfaces are in much less demand than for other non-ferrous metals. He has, however, given a most useful survey of the historical development of chromate treatments for this purpose and lists a number of current American applications, together with the results of outdoor exposure and other service tests. The latter included 8 months outdoors exposure of chromated and unchromated galvanized drums filled with 100 Octane petrol. The chromate treatment prevented zinc salt formation, colour fading of the petrol and reduction of ethylene dibromide.

### References

- (1) Metal Finishing, 1957, 55, (10), 74.
- (2) Plating, 1957, 44, (9), 963-968.
- (3) Steel, 1957, 141, (20), 132, 134.
- (4) Plating, 1957, 44, (9), 969-970.
- (5) Ibid, 971-974.
- (6) Iron Age, 1957, 180, (23), 139.
- (7) Products Finishing, 1957, 22, (1), 60-64, 66, 68, 70, 72.

# Accidental Contamination of a Bright Nickel Solution

## A PUZZLING CASE HISTORY<sup>†</sup>

Related by J. CORBIERE \*

**D**URING the course of last spring, the authors' company received a telephone call from a client stating that for four days, it had not been possible to obtain one single nickel-plated part from any one of three bright nickel baths.

The firm concerned had an important nickel and chromium-plating plant, in which are incorporated three bright nickel baths, each of 6,000 litres which are placed side by side and which work throughout the year at the rate of 8 hours a day, and often even on a double shift. Laboratory testing of the solutions was regularly carried out and, moreover, samples were sent to the author's company for analysis and correction.

For three days the company had tried all the corrections which they thought they should make without obtaining improvement.

Not knowing what else to do, the head of the firm brought to the author parts treated in his plant and a sample of the chemicals introduced into the bath, such as sulphates or chlorides and the brighteners supplied.

The parts all had white powdery deposits, spots, and the nickel was barely bright.

The following test procedure was then carried out.

- (1) With the client's solution a Hull Cell test was made and it was verified that the defects observed on the parts were reproduced on the Hull Cell, *i.e.* powdery and semi-matt deposits and spots.
- (2) In order to dissipate any doubts which the client might have regarding the purity of the brighteners or salts with which he had been supplied, a new bath was reconstituted with the samples brought. The Hull Cell demonstrated that the products were not the cause of the trouble.
- (3) Purification with permanganate and active carbon was carried out without obtaining any better result.

The client was then asked whether in his production he treated parts of aluminium. The client then declared that he had reason to suspect

sabotage on the part of his staff and that he admitted the possibility of the introduction into the three baths of a certain quantity of aluminium powder. A Hull Cell test was made on a new bright nickel bath with the admixture of 200 mg. per l. of aluminium and the same symptoms were observed as in the bath of the client. This led to an attempt to eliminate the presence of aluminium by raising the pH to 5.5 minimum by means of nickel carbonate and carrying out a filtration.

Progressive additions were tried of 2 g. per l., then 4 gm. per l., without being able to obtain a pH beyond 4.5. Successive additions of up to 10 gm. per litre of nickel carbonate still did not raise the pH above 4.5.

The author was aware that it would be impossible to arrive at the pH of 5.5 (which was necessary) by simple additions of nickel carbonate, which would in any case have been extremely expensive.

In conjunction with Plating-Chemie, Holland, further tests were then carried out.

(1) After analysis of the constituents of the solution, no anomaly was found and a test with the Hull Cell demonstrated the impossibility of producing a good deposit. The Hull Cell gave the following results:

- above 20 amp. per sq. dm.: greatly burned
- from 20 to 12 amp. per sq. dm.: presence of white powdery deposit
- from 12 to 3 amp. per sq. dm.: matt deposit and greatly stained
- under 3 amp. per sq. dm.: not very bright deposit.

(2) The quantity of permanganate of potash used for determining a possible excess of organic impurities was normal.

(3) Treatment with active carbon did not give any result. The client had, incidentally, a few weeks earlier purified his solutions with permanganate of potash and active carbon, as is his habit every year. The impurity had to be looked for therefore in the inorganic constituents; the methods of Dr. Odekerken<sup>(1,2)</sup> were used.

(4) As the presence of aluminium was suspected, the investigation in this direction was very carefully carried out, but without positive result.

(5) About 25 reactions for the identification of

<sup>†</sup>The full text of this contribution, of which only an abstract is published here was contained in a paper presented to the Distributors Conference, organized by the Electro-Chemical Engineering Co. Ltd., at Weybridge, October 2, 3 and 4, 1957.

\*Ets. R. Corbiere



foreign metals (cations) were carried out. Nothing positive was revealed except potassium, manganese and calcium, the presence of the first two being explained by the fact that a recent purification had been affected, whilst the presence of calcium originated from the hard water used in the works. However, the three above metals were in concentrations which could not be in any way detrimental.

As the impurity to be determined was not either organic or metallic, it was concluded that it existed among the anions, and as the potassium permanganate was not in excess, it was possible to eliminate any investigation on the reducing anions.

(6) A reaction made as a test showed that it was not a question of oxidising anions.

(7) Following on this, ten anion reactions enabled a weak nitrate and a strong phosphate reaction to be obtained. As the concentration of nitrates was only a few mg. per l. it could be ignored. The phosphate reaction revealed 6 to 8 gm. per l. of phosphate.

#### The Deposit on the Hull Cell and the Parts Treated

As nickel phosphate precipitates at a pH of 6.3, unlike nickel hydroxide which does not precipitate except at a pH of 7.2, difficulties are experienced in nickel-plating in solutions at a pH of 5.5 to 6.0. In this case, the nickel phosphate will deposit in the form of a greenish-white powder on a Hull Cell plate or on the parts to be nickel-plated.

The explanation for the presence of the phosphate proved to be simple. The client had installed in the same large shop (approx. 50 metres in length by 20 metres in width), a nickel-chromium plating line and parallel to this a complete phosphating line. He therefore constantly used chemically pure sulphuric acids (at 66° Bé) and phosphoric acids at 55° Bé.

The works' chemist having asked the supply warehouse for sulphuric acid for adjusting the pH of the nickel baths, the storekeeper made a mistake and forwarded 2 carboys of phosphoric acid. The latter acid, without anyone finding out the error, was added in required proportions to the three nickel baths.

The first addition of phosphoric acid had only a very slight effect in reducing the pH to 3 and the nickel-plating did not show any improvement.

The foreman of the nickel-chromium plating line thought it would be a good thing to make a second addition of acid, thinking, in good faith, that he was dealing with sulphuric acid. Naturally the result was less and less good, production was stopped and investigations commenced in the client's works.

During the course of the investigations a third addition of phosphoric acid was made, the pH always having a tendency to rise rapidly.

The baths could not be purified by a simple adjustment of the pH to 6.0 followed by filtration because in the first place the phosphates had probably not been entirely precipitated and in the second place too large a quantity of nickel hydroxide had been formed.

As, on the other hand, iron phosphate precipitates at a pH of 2 to 3, a part of the phosphoric acid was precipitated by adding iron perchloride. It was sufficient following on this to precipitate the remainder by simply bringing the pH to 5.1 as follows :

The temperature of the solutions having been brought to 60°C., there was added per litre of electrolyte :

2 g.m. of iron perchloride (previously dissolved in tepid water).

4 g.m. of nickel carbonate.

5 g.m. of sodium hydroxide in solution at 20 per cent.

The baths were then very carefully stirred in the course of adding these three salts. The pH obtained was 5.0 to 5.1.

After the baths had been left to settle for 24 hours they were filtered by decanting and then reintroduced into the respective tanks.

After a momentary re-adjustment of the pH to 4.0 (by means of sulphuric acid this time) the electrolytes gave good results. Later on the pH was progressively taken to 3.0 to 3.2.

The loss of solution, by reason of the large quantity of sludge formed by these operations, was approximately 20 per cent, but it was nevertheless possible to save solution to the value of some 300,000 Belgian francs.

#### References

- (1) Method I of Dr. J. Odekerken. "Investigation into the qualitative analysis of cations and a quick method for their identification." *Industrie Chimique Belge* 1950, No. 2.
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### HONOUR FOR I.M.F. PAST PRESIDENT

A past-president of the Institute of Metal Finishing, Mr. Roy Hammond, has been awarded the O.B.E. in the New Year Honours List.

Mr. Hammond is a principal scientific officer at the Armament Research and Development Establishment of the Ministry of Supply.

He has been active in the affairs of the Institute of Metal Finishing (formerly the Electrodepositors' Technical Society) for more than 20 years, and was nominated by the Council to represent the Institute on the productivity team on metal finishing which visited the U.S.A. in 1950. He was President of the Institute during 1956/1957, and has held other offices including the vice-presidency and membership of the Council.

## Polishing of Aluminium and its Alloys

(Continued from page 10)

fabricates and electroplates other jewellery made from tin-lead alloys. Other aluminium work to be chemically polished in large quantities includes cigarette holders, cigarette-lighter parts and various light fittings. On an average, about two-thirds of this aluminium is 99.5 per cent. purity, and the throughput averages about 1,400 sq. ft. surface area per day. The company operates a small (35-gallon) Phosbrite tank which, because of its size, is heated satisfactorily by direct gas burners. All aluminium is degreased before polishing.

Metal Finishes Limited, of Birmingham 18, chemically polish a variety of parts of all shapes and sizes, including holloware, lids, tea pots, trays, decorative trim for cars and radios, toilet requisites, cycle and electrical components and sheet from which buttons are fabricated. Their polishing tank has a working capacity of about 110 gallons and a throughput of approximately 1,000 sq. ft. surface area per day, all of which is commercial purity aluminium. Only a very small proportion of this aluminium is mechanically prepolished before going into the Phosbrite tank.

Acorn Anodizing Limited, of Hanwell and Boreham Wood, are another large firm specializing in the treatment of aluminium who operate a Phosbrite tank of 300 gallons capacity. Most of the articles treated by them are fabricated in commercial aluminium or its alloys or in S.P.

aluminium which has a broken or patterned surface. The company also operate an electrobrightening process which is used chiefly for the treatment of S.P. and S.P. base alloys. Their current production consists of such items as reflectors, badges, cosmetic containers, refrigerator trim etc.

Haynes, Ford and Elliott Limited, of Birmingham 6, also operate a 300-gallon Phosbrite tank, with a throughput of about 3,500 sq. ft. surface area per day. Of this, about a third is S.P. aluminium or alloy of 99.8 per cent. purity or better, half is 99.5 per cent. purity, and the remainder of other commercial grades. The work includes a considerable quantity of kitchenware, reflectors for light fittings and electric fires, and patterned work for use in refrigerators; there is also a rapidly increasing throughput of car trim, including wheel discs and interior brightwork.

The present huge domestic market for most of the products described above is characterised by highly competitive prices on the one hand, and the need for products to have strong and immediate sales appeal on the other. An important advantage of chemical polishing over electro-polishing is that it extends considerably the range of products for which commercial aluminium can replace S.P. grades without sacrificing anything in quality of finish. The additional property of Phosbrite 159, that it enables other types of work, involving all grades of aluminium, to be treated in the same solution, should ensure its use in many fields besides the domestic market.

## Swedish Electroplating Practice

(Continued from page 16).

this direction is shown by Ford Motor Co. in their new plant, and it will be very interesting to follow future developments in this particular field.

Zero-Mist has met with success in Sweden and has fulfilled all expectations. During the last two years several new chromium plating installations have been made on which no exhaust fans are provided, and chromium platers all over the country report that working conditions are much better with Zero Mist in the chromium plating bath than with the most elaborate mechanical exhaust devices. Practically all Zero Mist users also report that the throwing power is better with Zero Mist in the bath than without. Zero Mist has not yet met with official approval from the factory inspection board, but the factory inspectors recommend its use everywhere.

A definite use has also been found for Zero Mist in electro-polishing solutions for stainless steel. About 1 gram per litre of Zero Mist added to a mixture of phosphoric acid and sulphuric acid definitely aids in the electropolishing of large flat surfaces in reducing the tendency towards pitting,

lessening drag-out and giving overall better working conditions.

With regard to cadmium and zinc plating in Sweden it can be said that cadmium plating is carried out on a surprisingly small scale. Bright zinc plating followed by chromate passivating is on the other hand very much used, and will tend to increase, since important manufacturers of armaments and munitions have decided to change over from phosphatizing to zinc plating and passivating.

Copper plating is used as an under coating for nickel and chromium and the two car manufacturers in Sweden, Volvo and Saab, specify a minimum of 40 microns copper, 25 microns nickel and 0.25 microns chromium. Practically all the copper plating is at present being carried out in so called high-speed copper-plating baths of the cyanide type. There are many troubles with these types of solutions. The temperature in the solutions are high, porosity and roughness are common, waste disposal becomes more and more of a problem, and so forth. The author's opinion has always been that acid copper plating must be preferred with these heavy coatings, especially if the acid copper deposit could be made reasonably bright and smooth.



## FINISHING

## NEWS REVIEW

## DEGREASING EQUIPMENT FOR NOTTINGHAM FACTORY

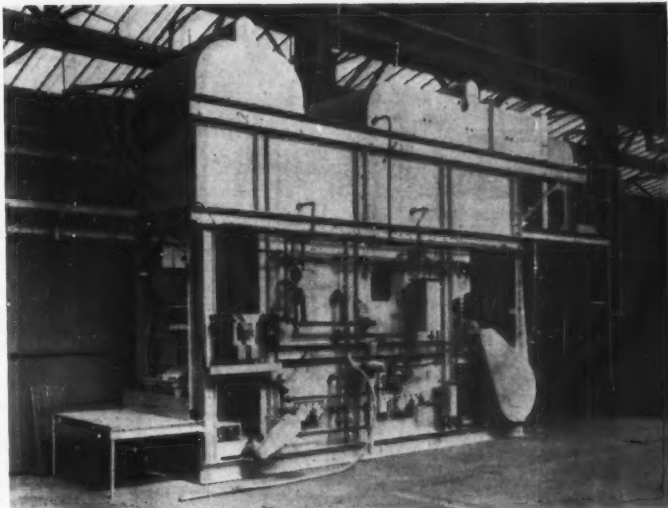
Repeat Order Underlines Suitability of Older Methods of Treatment

**A RECENTLY-OPENED** extension to the Raleigh Industries Ltd. factory at Lenton, Nottingham, has been equipped with many modern devices to increase productivity and the quality of the finished products.

The equipment, ordered from Imperial Chemical Industries Ltd., includes 12 "Cassel" heat-treatment furnaces and one metal degreasing plant with a total value of more than £33,000. The order for this type of heat-treatment equipment would seem to indicate that molten salt baths are maintaining their popularity as a method of treatment in the face of competition from gaseous systems.

Six of the furnaces are each 42-ft. long and are conveyerised to handle work automatically through pre-heat, carburising, quench and wash. Two of the remaining furnaces are also entirely automatic, and are to be employed for the refining treatment after case-hardening of small parts, such as bearings and 3-speed gear components, which can be transferred from one container to another. The four remaining plants are for deeper carburising on a batch system, the work being handled by overhead runway.

The continuous trichloroethylene degreasing plant, with the exception



Above is a photograph of the degreasing plant before installation. A basket is seen at the loading end on the left.

of some minor modifications and a 25 per cent increase in capacity, is similar in design to an existing plant supplied by I.C.I. some years ago. It is designed to degrease 200 tons of cycle parts during a working week

of 100 hours, and will be used to remove the lubricant with which the parts become contaminated during the several stages of pressing.

Many parts are degreased more than once, initially to permit inter-stage annealing, and then in preparation for subsequent processing. Rotating baskets are fixed to a double-chain conveyor, and the work is "tumbled" during passage through trichloroethylene liquor and vapour compartments to ensure efficient degreasing and to prevent the loss of solvent trapped in "cupped" or close-lying parts.

As a further aid to economical and safe operation, the plant is fitted with an activated carbon recovery unit to recover solvent from the air exhausted at the plant inlet and outlet hoods. Similar arrangements on the original plant ensured operation at a highly economical level, more than 3 tons of work being cleaned for the consumption of 1 gallon of solvent.

A HAPPY AND PROSPEROUS  
NEW YEAR

The Editors, the Area Managers, and the Staff of METAL FINISHING JOURNAL extend to all readers, advertisers, contributors and other friends in the industry at home and overseas, sincere and cordial good wishes for their happiness and greater prosperity in the year that lies ahead.



Mr. W. H. Apthorpe, until recently managing director of the Cambridge Instrument Co. Ltd., 13, Grosvenor Place, London, S.W.1., has retired, but has retained his seat on the board, and will continue to be available for special duties as deputy chairman.

Mr. Apthorpe has been succeeded as managing director by Mr. H. C. Pritchard who, until recently, held a senior responsible position with Elliott Bros., and has had a distinguished scientific and administrative career. After taking high honours at Oxford he went to the Air Ministry on research and development work and in 1939 he was appointed head of the Navy section at the R.A.E. After the war he became head of the blind landing experimental establishment at Martlesham for a period and then returned to the R.A.E. as head of the instrument and photographic department. In 1949 Mr. Pritchard was seconded to the Australian Government as chief superintendent of the Woomera rocket range and after a successful period in that capacity returned to this country to join Elliott Bros.

The retirement has been announced of Dr. J. E. Hurst, deputy chairman and managing director of Bradley and Foster Ltd., Darlaston; Bradley (Darlaston) Ltd.; Bradley (Concrete) Ltd.; and Arblaster and Co. Ltd., Kings Hill, Wednesbury, on grounds of health. He is a Past-President of the Institute of Vitreous Enamellers.

Dr. Hurst, together with the late Mr. G. T. Lunt, has probably more than anyone else been responsible for the growth of the Bradley and Forster group over the past 30 years. Following service with a number of companies as metallurgist, he became technical advisor to Bradley and Foster Ltd., in 1926, technical director in 1949 and deputy chairman in 1952.

Throughout his working life Dr. Hurst has been associated with iron founding and cast iron metallurgy. His many activities include the invention and development of the centrifugal casting process, the heat treatment and nitrogen hardening of cast iron, and the production of alloy cast iron. He has been closely associated with numerous technical associations and has presented a number of papers on a variety of

## TECHNICAL and INDUSTRIAL APPOINTMENTS

metallurgical subjects. His activities in this connection were recognised by his election as president of a number of these societies. In 1939 he was awarded a degree of Doctor of Metallurgy of Sheffield University, and in 1956 a Doctor of Engineering of Karlsruhe University, Germany. Further recognition of his services to industry was made in 1953 when he was made a C.B.E. (civil) in the Coronation Honours list.



Dr. J. E. Hurst, J.P.

Dr. Hurst has taken a leading part in public life in the City of Lichfield where he resides. He was made a J.P. in 1942, was sheriff of Lichfield in 1946, and Master of the Worshipful Company of Smiths in 1952.

Dr. Hurst will remain in an advisory and consultative capacity with the group and will also continue as a director of the parent company, T. Staveley Coal and Iron Co. Ltd. Consequent upon the retirement of

Mr. G. E. Lunt



Dr. Hurst, Mr. G. E. Lunt, only son of the late Mr. G. T. Lunt, who was managing director from 1923 until his death in 1949, has been appointed managing director in succession to Dr. Hurst, and Mr. J. L. Allen, secretary and director, has been appointed deputy managing director.

Mr. G. E. Lunt returned to the company after completing his military service in 1946. He was appointed general works manager in 1949 and a director in 1954. He is president of the Foundry Trades Equipment and Supplies Association and hon. treasurer of the Staffordshire Iron and Steel Institute.

Mr. J. L. Allen joined the company in 1940, was appointed secretary in 1947 and a director in 1954. He is a fellow of the Chartered Institute of Secretaries and a J.P. in the County of Stafford.

\* \* \*

J. M. Kape, B.Sc., A.R.I.C., L.I.M., formerly of the research division of High Duty Alloys Ltd., Slough Bucks, has joined **Alumilite and Alzak Ltd.**, Priory Works, Station Road, Merton Abbey, London, S.W.19, as chief research and development chemist.

\* \* \*

The appointments of Mr. Albert P. Gagnebin and Mr. L. E. Grubb as assistant vice presidents of **The International Nickel Company, Inc.** have been announced by Mr. Henry S. Wingate, president of the company.

Mr. Gagnebin continues as manager of the nickel sales department, which is responsible for the company's sales and distribution of primary nickel products in the United States.

Mr. Grubb, who has been general superintendent of the Huntington, West Virginia, works of International Nickel since May, 1953, will be in charge of labour relations at all United States plants. He will transfer to the company's New York office.

\* \* \*

**Aero Research Ltd.**, Duxford, Cambridge, and **Ciba Ltd.**, Horsham, Sussex, announce that Air Commodore Sir Arthur Vere Harvey, C.B.E., M.P., has accepted the chairmanship of the boards of directors of these two companies. In this appointment he succeeds Sir Raymond Needham, Q.C., who has been chairman since 1947 and remains a director of both companies.

## Retirement after 36 years Service



Mr. A. J. Somers

Mr. A. J. Somers, F.R.I.C., retired recently after 36 years service with Borax Consolidated Ltd.; since February 1946 he has been a member of the board of the parent company, now Borax (Holdings) Ltd.

Originally engaged as a scientist, Mr. Somers spent many years between the wars investigating and promoting the industrial uses of borates; he became sales manager of the company in 1940. At the end of the war he travelled widely overseas, reviewing the company's interests in many parts of the world. He was responsible for developments in technical service and research, expanding considerably the company's interests and activities.

His many friends in the scientific world, and in the numerous British and overseas industries, in whose technical problems he took a close and constructive interest, will wish him all health and happiness in his retirement.

### LECTURES ON THEORETICAL PRINCIPLES OF ELECTRODEPOSITION

THE department of applied chemistry of the College of Advanced Technology, St. John Street, London, E.C.1. have arranged a short lecture course on the theoretical principles of electrodeposition, to be given by Dr. D. J. Alner, senior lecturer in electrochemistry.

Eight lectures (to be followed by discussions) will be held on Monday afternoons at 2.30 p.m., commencing February 3, next.

The syllabus will comprise:—polarisation phenomena and their application to metal deposition; principles of alloy deposition; anodic phenomena and anodising of aluminium; factors affecting the character of metal deposits; control methods; specification and inspection of deposits; and analysis of plating solutions.

Fee for the course is £1. Enrolment can be made either in person at the college or by post, in which case those wishing to enrol should supply the following information: (a) name and address; (b) qualifications; (c) name of employer (required for record purposes only). The fee and a stamped addressed envelope should be enclosed with the application.

### BRITISH TITAN MOVE

HEAD office of British Titan Products Co. Ltd., has been transferred from York to London. The new address is 10 Stratton Street, London, W.1., where all communications should be sent.



### LONDON FACTORY'S NEW COATING PLANT

AT their new factory in Tottenham, Siemens Edison Swan Ltd., are now equipped to coat articles of almost any size with polytetrafluoroethylene. Newly installed plant includes sintering ovens capable of accepting parts comparable in size to a double-decker bus, and conveyor ovens can handle large quantities of small parts. This process results in a completely inert and non-stick surface with an almost zero coefficient of friction.

## MEETINGS OF THE MONTH

January 16

**Oil and Colour Chemists' Association (Scottish Section).** "Toxicity of Solvents in Industry," by Dr. R. Piper (I.C.I. Ltd.), at More's Hotel, India Street, Glasgow, at 7.15 p.m.

January 20

**Institute of Vitreous Enamellers Ltd. (Midland Section).** "Electric Furnaces for Fusing," by H. Bryan, at the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2, at 7.30 p.m.

January 28

**Metal Finishing Association.** "Education in Finishing," by Dr. J. E. Garside (Principal, Borough Polytechnic, London). Luncheon meeting at the Farcroft Hotel, Rookery Road, Handsworth, Birmingham 21.

January 31

**Incorporated Plant Engineers (Birmingham Branch).** "Trade Effluent Treatment," by J. Lakin (Chief Chemical Engineer, Wm. Farrer Ltd.), at the Imperial Hotel, Temple Street, Birmingham. 7.30 p.m.

February 6

**Birmingham Paint, Varnish and Lacquer Club.** "Some Recent Developments in Epoxide Reactions in Surface Coatings," by T. C. Moorshead and Dr. C. A. Weeks, at the Imperial Hotel, Temple Street, Birmingham. 7.50 p.m.

February 6

**Institute of Metals (London Local Section).** "Corrosion by Liquid Metals," by B. R. T. Frost, at the Institute's premises, 17 Belgrave Square, London, S.W.1. 6.30 p.m.

February 12

**Institute of Metal Finishing (Organic Finishing Group).** "Method Study as Applied to the Paint Shop," by B. H. Fewings, at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1. 6.30 p.m. (The same subject will be taken for a meeting of the Group at the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham 2, on January 22, at 6.30 p.m.).

February 13

**Oil and Colour Chemists' Association (Scottish Section).** "Polyesters, with particular reference to Surface Coatings," by Dr. H. W. Keenan (Beck, Koller and Co., England Ltd.), at More's Hotel, India Street, Glasgow, 7.15 p.m.

February 13

**Institute of Sewage Purification (Midland Branch).** "Observations on the Ministry's Methods of Chemical Analysis as Applied to Sewage and Sewage Effluent," by L. Klein. Chamber of Commerce, New Street, Birmingham. 2.30 p.m.



## NEW COMPANIES

"Ltd" is understood, also "Private Co."  
Figures = Capital, Names = Directors, all unless otherwise indicated.

**Cawdor Paint Co.**, 573, Eccles New Road, Weaste, Salford, 5. November 13. £100. Winifred Pillinger, Emily M. Gibson.

**Hoole Ceramics**, 39a, Bank Street, Sheffield. November 13. £10,000. C. B. Hoole, E. Hattersley, Margaret L. Hoole and D. T. Price.

**Upkeep**, 127, Western Road, Brighton. November 13. £100. To carry on bus. of retailers of paint, enamel, etc. W. Bragg, J. W. Scully.

**Herbert (Hammersmith)**, 220, King Street, W.6. November 19. £1,000. To carry on bus. of manufacturers and dealers in paints, enamels, varnishes, etc. W. G. J. Herbert, R. J. Norgate.

**Southern Polishing Co.**, Balfour House, Finsbury Pavement, E.C.2. November 19. £150. To carry on bus. of platers, polishers, general finishers to jewellery trade, etc. P. G. Denton, N. L. Gibson.

**Abrasive Specialities**, 15, Avenue Parade, Accrington. November 27. £7,000. J. P. Rosenberg, J. B. Titterington, E. S. Rosenberg and M. S. Sutcliffe.

**North Western Electro Plating Co.**, 12, Garfitt Street, Oldham. £1,500. December 2. F. Wilson, J. Wright, R. Worstencroft.

**Accurate Grinding Co.**, 103-109, Queen Street, Sheffield, 1. December 3. £1,000. To carry on bus. of precision engineers, machinists, etc. P. C. J. T. Kirkman, R. E. Kay.

**Strip Tinning** Lewisham High Street, S.E.13. December 5. £500. To carry on bus. of metal enrobers, metal sprayers, etc. C. J. A. Barton, W. Collie.

**Rose Chrome Sales**, 88/90 Hatton Garden, E.C.1. December 6. £1,000. To carry on bus. of dealers in and agents for the sale of chrome ore, concentrates, metals, etc. I. H. Rosenberg and Anne N. Rosenberg.

From the Register compiled by Jordan & Sons Ltd., 16, Chancery Lane, London, W.C.2.

## TRADE and TECHNICAL PUBLICATIONS

"The Nickel Bulletin" is a monthly summary of current information published by the Mond Nickel Co. Ltd., Thames House, Millbank, London, S.W.1.

Vol. 30, No. 9, has as its main feature the effects of impurities in nickel plating solutions and method of purification. The information is based on reports of the American Electroplaters' Society Research Project No. 5, and is presented as a table.

The publication is divided into sections containing abstracts of current published information of nickel and its alloys.

One section headed "Electrode position and other coating methods" lists eight recently published references to the subject. Under the heading "Heat and corrosion resisting materials" references are given of recent articles that have appeared in the technical press on the subject.

"Bright Gold Plating" is an 8-page paper by E. C. Rinker of the American Sel-Rex Corporation, Nutley, N.J., U.S.A. The paper has been reprinted many times since its original presentation to the 40th Annual American Electroplaters' Society.

The paper treats in detail such subjects as bath composition, equipment and operating conditions, and comparative metallurgical characteristics of 24-K. gold plate on various base metals. Illustrations include photomicrographs of the plating's cross-section and surface, and there are a series of graphs and tables indicating rates of deposition at various current densities and under different operating conditions.

Copies may be obtained free of charge on application to the Sel-Rex Corp., P.O. Box 187, Nutley 10, New Jersey, U.S.A.

"Coated Abrasive Belts" is the name of a handbook now available from Norton Grinding Wheel Co. Ltd., Welwyn Garden City, Herts.

The handbook is intended to remind those who use abrasive belts of the few simple rules that if adhered to will improve economy and performance figures. Tips about well-known, but not always well-remembered, things like the right height for the "crown" on pulleys, the belt's running direction, alignment and tension; friction and fitting; storage and handling, are described and illustrated with thumbnail sketches. Copies can be obtained free on request.

"Pipe Fitting Bulletin" has been issued recently by Horwath-Smith and Co. Ltd., Pensnett, Brierley Hill, Staffs, to describe the range of Oxythene pipe fittings being made by the firm. The fittings are available in a complete range of sizes and types. Mention is also made of the company's new Oxythene high-impact grade P.V.C. tubing now in production in all sizes up to 6-in. dia.

The pipes and fittings are intended for chemical plumbing, and the leaflet can be obtained free on request.

"Hosepipe and Hose Fittings" is the title of Section 1 of a new accessories catalogue being prepared by the Consolidated Pneumatic Tool Co. Ltd., 232 Dawes Road, Fulham, London, S.W.6. This section is a 10-page brochure giving full information about the wide range of these components available from the company. Information is also included about a pocket airline testing gauge and a pneumatic duster, together with details of automatic drain taps, aircocks, hoseclamps, and 3-way couplings.

"Cellon Bulletin" is a quarterly review of the latest developments in paints and protective finishes for all purposes, and is published by Cellon Ltd., Kingston-on-Thames, Surrey. This issue carries on the front page a description of zinc-coated sheet prepared at the Shotton works of John Summers, Sons Ltd.

The position of zinc in the electrochemical series of metals is such that it acts sacrificially and expends itself resisting rusting of the steel underneath if it is scratched. This property has been exploited to the full in the familiar hot dip galvanizing method, and latterly in the introduction of metallic spraying processes. Both these methods have limitations when applied to large-scale sheet metal production, and alternative methods of producing a zinc-coated sheet were sought. In 1947, John Summers commenced making metal sheet which had a coating of electro-deposited zinc. Other producers have since taken the field.

At Shotton, open-hearth steel is reduced on a strip mill, cut to size, and fed into the automatic zinc-coating plant. The deposited surface is from 0.001- to 0.005-in. thick. Complex bath treatment for de-rusting steel is no longer necessary, and in many cases, pretreatment can be obviated. The lubricating properties of the zinc coating also increases tool life in subsequent press work.



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## TECHNICAL BOOKSHELF



**Electroforming of Waveguide Components for the Millimeter-Wavelength Range.** Albert A. Feldmann, National Bureau of Standards Circular 587, issued November 15, 1957, 16 pages, 15 cents. (Order from Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.).

**I**N the millimeter-wavelength range, electroforming represents almost the sole method of construction for precision waveguide components, due to the mechanical tolerances required. However, very few commercial electroplaters offer such services.

This publication outlines the procedures and the materials necessary for the production of high-quality millimeter components with a minimum of equipment, time or specialized knowledge of electro-deposition. This can be done with machine-shop facilities, normal laboratory facilities, and a few auxiliary items.

This circular includes sections on: metals to be deposited, the required equipment, the mandrel, cleaning process, masking of mandrels, and electro-deposition. A list of helpful literature and the title of a book containing sources of supply are appended.

**Note:** Foreign remittances must be in U.S. exchange and should include an additional one-fourth of the publication price to cover mailing costs.

**ASTM Standards on Copper and Copper Alloys.** American Society for Testing Materials. 1916, Race Street, Philadelphia 3, Pa., U.S.A. 688 pp. \$6.25 (cloth covers \$7.00).

**A** NEW edition of the special compilation of ASTM standards covering copper and copper alloys, cast and wrought, has recently been published. Thirty-four of the 128 standards included in the now obsolete December, 1955, edition were revised in 1956 and 1957, and the revised standards are in the new edition. Also included for the first time are specifications for threadless copper pipe and for copper drainage tube.

Products covered include basic coppers, non-ferrous metals used in the manufacture of copper alloys, copper and copper alloy wrought products including electrical conductors, copper alloy ingots and castings, and copper and copper alloy filler metal. Test methods for these materials accompany the specifications. A 16-page index appears at the back of the book.



PAINT MANUFACTURERS AT THE SMITHFIELD SHOW

### ADVANCED PURCHASING COURSE

**T**HE Purchasing Officers Association, Wardrobe Court, 146a, Queen Victoria Street, London, E.C.4, is holding an advanced purchasing course from April 14 to 19, 1958, at Christ Church, Oxford.

It will be conducted by Dr. Howard T. Lewis, A.M., LL.D., Professor of Marketing, Emeritus, Graduate School of Business Administration, Harvard University.

### ALUMINIUM TRAM FOR WORLD FAIR

**H**UNGARY'S first aluminium tram began its trial run at the beginning of this month, and was then shipped for showing at the Brussels World Exhibition which begins in April. The use of aluminium gives an overall saving in weight of 16 per cent and thus increases possible operating speed.

**SEEN** above is the stand which Robt. Ingham Clark and Co., makers of Britannia industrial finishes, Westmorland House, 127-131 Regent Street, London, W.1., occupied at the recent Smithfield Show. As in recent years, this was the only firm of paint manufacturers to be represented at a show at which livestock is shown and judged first on the hoof, and later as meat.

### CORROSION EXHIBITION

**T**HE corrosion group of the Society of Chemical Industry is organizing an exhibition of research and development in protective coatings and allied corrosion control measures at the Battersea College of Technology, Battersea Park Road, London, S.W.11 on January 23 and 24.

On the first day, the entrance to the exhibition will be restricted to members and their friends attending the group's annual *conversazione*, for which tickets are required. But on January 24 the exhibition will be open to all, without tickets, from 9.30 a.m. to 3.30 p.m.

# ***Latest Developments*** **in** **PLANT, PROCESSES AND EQUIPMENT**

## **Improvements to range of barrelling machines**

**T**HE stationary fixture machines made by Roto-Finish Ltd., Mark Road, Hemel Hempstead, Herts, now incorporate new features designed to eliminate the difficulties previously encountered when manoeuvring a fully loaded fixture into the barrel, or in securing the fixture rack in position. In addition, a new model with a capacity of 26 cu. ft. has been introduced to complete a range of 4 sizes, extending from 18 cu. ft. to 73 cu. ft. Seen below is the additional model, known as the DW 45/36/1 (Fig. 1).

A larger door occupying two flats of the octagonal shape now provides easier access to the interior of the barrel. A guide rail down the interior of each side of the barrel, held in place by two bolts, enables the rack to be rapidly secured. The guide rails are removable, and the four guide-rail securing bolts can be replaced by rubber-headed bolts. Consequently the same machine can be used for free barrelling as well as for fixture barrelling.

The machines are fitted with a variable speed mechanism to cater for a variety of work and finishes, including the processing of large or delicate components.

## **Hardener for epoxy resins**

**A** NEW curing agent for epoxy resins was announced recently by Furane Plastics Inc., 4516 Brazil Street, Los Angeles 39, Ca., U.S.A. Colourless, it will permit the development of epoxies having high temperature properties. Its

applications include not only high temperature tools, such as bonding jigs and fixtures for aircraft and welding equipment for metal industries, but also high temperature electrical service and important maintenance functions.

When cured with appropriate epoxy resins, such as Epocast 10 at 300°F., the agent, Hardener 929, will develop heat distortion temperatures of approximately 300°F. It is particularly interesting to users of epoxy resins because it is a non-staining and colourless type of hardener, overcoming many of the objections of earlier dark-coloured, staining varieties which have been introduced in the past.

## **Electrolytic polisher for the preparation of specimens**

**S**EEN in Fig. 2 is an electrolytic polisher based on apparatus developed by the Atomic Energy Research Establishment, Harwell, now being marketed by Shandon Scientific Co. Ltd., 6 Cromwell Place, London, S.W.7. The original apparatus has been described by Sykes, Haddrell Haines and Mott (*J. Inst. Metals*, **83** [1954-5] 166).

The polisher prepares specimens for immediate microscopic examination.

In operation, electrolyte is drawn through a centrifugal pump and is forced through a series

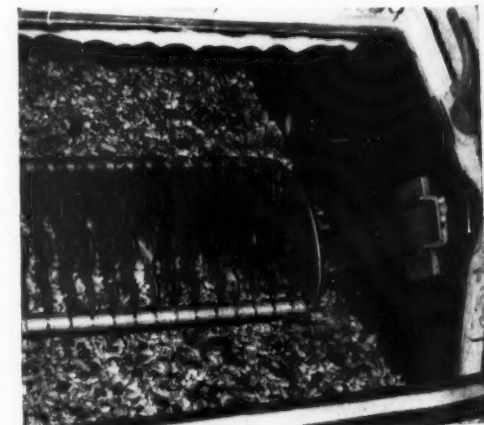
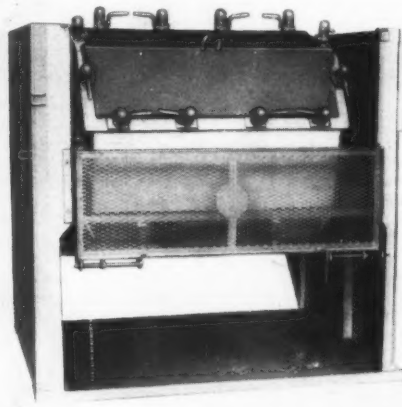


Fig. 1.—(left). A 26 cu. ft. barrelling machine with the safety guard lowered to show the improved door, occupying two flats of the octagonal barrel, and (right), the door removed to show the slotted guide rail supporting the work rack, in which a number of stator plates are mounted for processing.

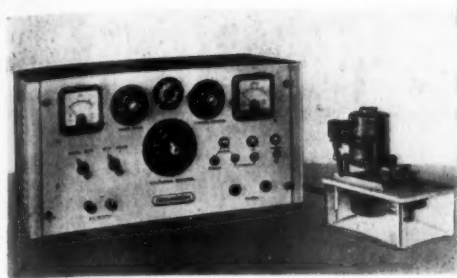


Fig. 2.—An electrolytic polisher to prepare specimens for immediate microscopic examination.

of holes where it contacts the specimen as a constantly rotating, continuously renewed liquid column, to ensure a perfect polish and quality finish without flow lines. Cold working and false deformation structures are eliminated, and specimen preparation is considerably simplified.

The polishing deck, mounted on rigid P.V.C., is a self-contained unit resting on the electrolyte tank, and contains the pump, specimen clamp and electrolytic cell. The power supply has separate D.C. outputs and controls for manual and automatic polishing and etching. Additional output terminals provide facilities for beaker etching when required. On "manual," all switches are independently and separately controlled by on/off switches. For operation on "automatic," the time switch is set to the required polishing period (within a range of 1 to 90 seconds). At the end of the period, both the pump and the D.C. are automatically switched off. Electrolytic etching can be carried out as part of the operation by switching to "etch" during the last seconds of the cycle.

### De-scaling pistol

A DE-RUSTING and de-scaling pistol is being marketed by John Trelawny Ltd., Brandon House, 54 Holly Walk, Leamington Spa, Warwick.

Termed the Jasons Model 3B Pistol, it is an air-operated hand tool requiring 12.5 cu. ft. of compressed air per minute at 90 lb. per sq. in. pressure to operate it. The pistol consists of a group of hardened steel needles, mounted in individual slots in a needle holder, propelled and retracted by a spring-loaded piston. The action is controlled by a trigger on the handle. Air flows continually over the working surface to remove the loosened scale and dust.

The complete kit comprises a pistol with holder for the 65 x 2 mm. flat-end needles and the 28 x 3 mm. chisel-end and pointed needles. Two interchangeable mouthpieces are provided, one round—for normal work—and one straight for cleaning

fillets, angles, bolt heads, etc. The working life of the needles is about 500 to 800 hours.

A chisel holder and three different types of chisel are included, together with spare needles and 30 ft. of  $\frac{3}{8}$ -in. air hose. The changeover from one attachment to another is made by loosening a single Allen-headed screw.

The tool has many applications in the cleaning and preparation of surfaces, and is especially suitable for cleaning in confined or awkward spaces.

### Gun for spraying ceramic coatings

A NEW process recently introduced by the Metallizing Equipment Co. Ltd., Chobham, Woking, Surrey, is claimed to reduce the cost of applying ceramic coatings. Based upon what the makers say is an entirely new principle, the process uses a Metco Thermospray gun to deposit high melting-point ceramic materials and a range of hard-facing alloys at high spraying speeds.

Compressed air is not required for the gun. A syphon-jet regulates and accelerates the powder being sprayed into a nozzle having a high thermal efficiency. A small, electrically operated vibrator, attached to the gun below the nozzle, is supplied for use with ceramic materials.

The gun can be used to apply such materials as alumina and zirconia, stainless steel and bronze. Spraying speed with the first two materials is about 15 sq. ft. per hr. at 0.010 in., and the average cost is about three shillings per sq. ft.

The hard-facing alloys of the nickel-chrome-boron type applied as coatings can be used in the "as sprayed" condition, although more normally they are fused to form an integral part of the base material.

Fig. 3.—A portable non-destructive coating thickness tester.



### Coating thickness testing apparatus

**A** NEW type of portable non-destructive coating thickness tester for both laboratory and production use has been developed recently in the United States by Unit Process Assemblies, Inc., 59 East 4th Street, New York, N.Y., U.S.A. (Fig. 3.)

It gives a direct reading of a coating on any base, including metallic and non-metallic coatings on a metallic base, or metal films on a non-metallic base.

Manufactured under the name "Dermatron", it is made with four probes to give a wide measuring range from thin to thick deposits, and requires only a  $\frac{1}{8}$ -in. circular area for measurement. The instrument can also be used for sorting and matching metals and alloys.

In operation, it is able to measure the thickness of coating on metals provided the conductivities of the coating and basis metal differ sufficiently, regardless of whether the materials are magnetic or not. The test is non-destructive.

Measurements are made by comparison with calibration scales of samples of known thickness, and the thickness of coatings that can be measured depends on the frequency of the exciting current used.

### Liquid polishing compounds

**W**HAT is claimed to be an entirely new range of metal and plastic polishing compounds in liquid form is now being manufactured by

Grauer and Weil Ltd., Hardwicke Street, London, E.C.1, under the general title of Aquapol.

The makers say that liquid polishing compounds have certain advantages over the more conventional solid bar compounds. Application of compound to the polishing mop is more uniform, better controlled, and the wastage which can occur with solid bar "nubbins" is eliminated.

The advantages claimed for the compounds are a close abrasive control, a low water content, and the absence of any tendency for the separation of liquid and abrasive either in use or in storage.

Aquapol is applied to the polishing mop by specially designed spray-gun equipment, using any one of three available systems. These comprise a single spray gun unit with self-contained compound container operated by foot control valve; a pressurised compound container feeding a number of spray guns; or a circulatory system in which a number of spray guns using the same compound are tapped into a main liquid compound supply line, the compound being pumped continuously in a closed circuit from a main, non-pressurised storage tank.

The product is non-inflammable and completely emulsifiable, and subsequent cleaning of polished articles prior to electroplating or lacquering is thus facilitated. Four types are at present in production, and it is planned to extend this range in the near future.

## ENAMELS and FRITS for CAST & SHEET IRON



COLOURING OXIDES  
MILLING CLAY  
RAW MATERIALS

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